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AERONAUTICAL ENGINEERING

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A SPECIAL BIBLIOGRAPHY

WITH INDEXES

Supplement 10

OCTOBER 1971

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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AERONAUTICAL ENGINEERING

A Special Bibliography

Supplement 10

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in September 1971 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA)*



INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering.

This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 413 reports, journal articles, and other documents originally announced in September 1971 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. For previous bibliographies in this series, see inside of front cover.

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the bibliography consists of a standard bibliographic citation accompanied by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries* in that order. The citations and abstracts are reproduced exactly as they appeared originally in *IAA* or *STAR*, including the original accession numbers from the respective announcement journals. This procedure, which saves time and money, accounts for the slight variation in citation appearances.

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All publications abstracted in this Section are available from the Technical Information Service, American Institute of Aeronautics and Astronautics, Inc (AIAA), as follows. Paper copies are available at \$5 00 per document up to a maximum of 20 pages. The charge for each additional page is 25 cents. Microfiche⁽¹⁾ are available at the rate of \$1 00 per microfiche for documents identified by the # symbol following the accession number. A number of publications, because of their special characteristics, are available only for reference in the AIAA Technical Information Service Library. Minimum airmail postage to foreign countries is \$1 00. Please refer to the accession number, e.g., A71-10613, when requesting publications.

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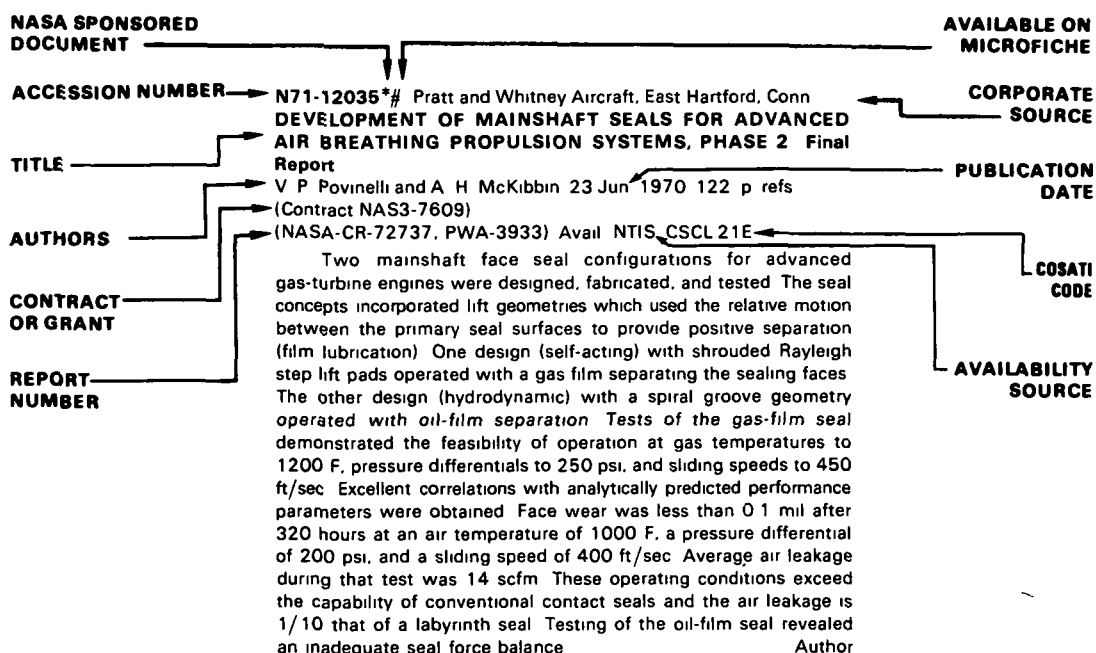
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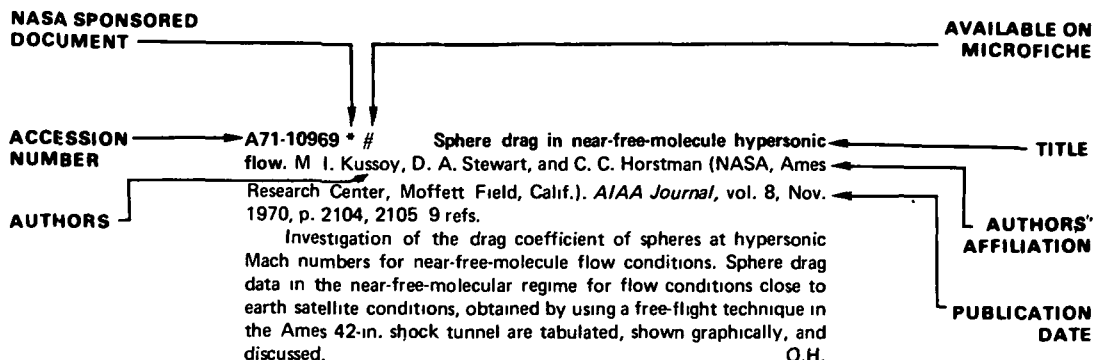
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TYPICAL CITATION AND ABSTRACT FROM IAA





AERONAUTICAL ENGINEERING

A Special Bibliography (Suppl. 10) OCTOBER 1971

IAA ENTRIES

A71-34189 # Detachment in turbulent incompressible plane flows on thick bodies (Décollement dans les écoulements plans incompressibles turbulents sur des corps épais). Haminh Hieu (Toulouse, Université, Toulouse, France) and L. Masbernat (CNRS, Paris, France) (*National Conference on Applied Mechanics, Bucharest, Rumania, June 23-27, 1969.*) *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée*, vol 16, no. 2, 1971, p. 375-394 19 refs In French

Summary of various tests of theoretical resolution of the detachment. The purpose of these theoretical approaches is the prediction of characteristic magnitudes of the phenomenon of detachment in external aerodynamics such as the base pressure, the vortex column characterized by the form of the jet line, and the evolution of the velocity profile in the mixing zone. Following an outline of the basic hypotheses of the study, methods for the case of detachment on a wall undergoing a sharp disconnection and on a plate normal to the wind are developed. Basic theoretical results characterizing the pressure and velocity fields on the body and in the vortex zone are given. These results are compared with experimental results obtained on aerodynamic models. F R L

A71-34190 # Comparative applications of a 'theoretical model' concerning the supersonic flow past a delta wing with flow separation at the leading edges. E. Carafoli and St. Staicu (București Institutul Politehnic Gheorghe Gheorghiu-Dej, Bucharest, Rumania). *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée*, vol 16, no 2, 1971, p. 395-407 7 refs

Study of the flow in the supersonic regime past a thin delta wing, considering the flow separations around the subsonic leading edges. As a result of the flow separation around the edges, two concentrated vortex nuclei of the same intensity and of opposite sign occur which will alter the field of vertical and horizontal velocities. As a means of simplification a 'theoretical model' is established by means of which the problem may be easily solved. A comparative study of the various kinds of distributions of downwashes on the wing by applying this theoretical model is presented. It is concluded that the mode of the downwash variation does not greatly influence the pressure distribution and the aerodynamic characteristics. F R L

A71-34209 # Distribution of viscous stresses in an incompressible turbulent boundary layer (Raspredelenie kasatel'nykh napriazhenii v neszhimayemom turbulentnom pogrannichnom sloe). P.

N. Romanenko and V. G. Kalmykov (Moskovskii Institut Neftekhimicheskoi i Gazovoi Promyshlennosti, Moscow, USSR) *Inzhenerno-Fizicheskii Zhurnal*, vol 20, Apr. 1971, p. 666-673 8 refs In Russian

Isothermal turbulent boundary layers with a positive pressure gradient are studied by means of axisymmetric and plane diffusers in an open-jet wind tunnel at Reynolds numbers between 48,500 and 202,000 at the diffuser inlets, using air as the working medium. It is shown that the distribution of viscous stresses in such layers can be approximated by a simple formula. V P

A71-34213 # Acoustic emission of subsonic turbulent jets (Akusticheskoe izluchenie dozvukovykh turbulentnykh strui). L. M. Viaz'menskaia (Mekhanicheskii Institut, Leningrad, USSR) *Inzhenerno-Fizicheskii Zhurnal*, vol 20, Apr. 1971, p. 711-716 10 refs In Russian

A method, based on Lighthill's (1963) wave equation, is proposed for calculating the noise intensity of turbulent jets. Noise levels in the far-field are obtained for various Mach numbers at the nozzle-exit section. The method proposed is applicable also to near-field calculations. V P

A71-34225 # Fan propulsion system influence on VTOL transport design. Aubrey M. Bland (McDonnell Aircraft Co., St. Louis, Mo.) *American Institute of Aeronautics and Astronautics and Society of Automotive Engineers, Propulsion Joint Specialist Conference, 7th, Salt Lake City, Utah, June 14-18, 1971, AIAA Paper 71-744* 8 p. Members, \$1.50, nonmembers, \$2.00

Some key design considerations are given to obtain the best overall airframe/propulsion combinations for VTOL transport propulsion systems. The effects of such combinations are evaluated in terms of VTOL thrust requirements, propulsion cycle optimization, aircraft performance, and aircraft control in the VTOL mode. The VTOL thrust requirements are shown to be most affected when the propulsion system designs are to perform lift, control and cruise functions simultaneously. It is also demonstrated that such a multifunction propulsion system can be designed with a cruise thrust matching an optimum specific fuel consumption cycle. The effects of fan design, location and response on aircraft control characteristics are reviewed. The combined effects of advanced technology and the multifunction propulsion system are projected to a VTOL transport anticipated for operation in the mid-80s. V Z.

A71-34240 # Prospects for the use and development of satellites for civil aviation and shipping. Bertrand Manuali (Centre National d'Etudes Spatiales, Paris, ESRO, Neuilly, Hauts-de-Seine, France) *ITU Telecommunication Journal*, vol 38, May 1971, p. 330-337 Translation

The nature and extent of the requirements of the satellite mobile service are examined and the charges which might be levied are estimated. It is suggested that a frequency band at around 5000

MHz should be selected for the satellite-ground station links and a spectrum between 1540 and 1660 MHz for the satellite moving-craft repeaters. In this case relatively high-gain antennas are required ranging from 10 dB for aircraft and from 13 to 15 dB for ships. The possibilities offered by modulation technique are examined. It is proposed that two generations of satellites should be envisaged in the Atlantic-Pacific system. The first generation operating between 1975 and 1980 would have a low communication capacity and would comprise at least three satellites in orbit, two over the Atlantic and one over the Pacific. For the second generation, which would be in service between 1980 and 1987, traffic capacity would be considerable, and there will probably be five satellites in orbit, two over the Atlantic, two over the Pacific and one over the Indian Ocean. Z W

A71-34424 # Approximate method of calculating the laminar boundary layer on a wing and on a body of revolution (Nablizhenii sposib rozrakhunku laminarnogo pogranichnogo sharu na krili ta tili obertannia). L. P. Kozlov (Akademiia Nauk Ukrain's'koï RSR, Institut Gidromekhaniki, Kiev, Ukrainian SSR) *Akademiia Nauk Ukrain's'koï RSR, Dopovidi, Seria A - Fiziko-Tekhnichni i Matematichni Nauki*, vol. 33, May 1971, p. 457-461. 13 refs. In Ukrainian.

A method which is based on an integral momentum relation, and in which the velocity distribution is approximated by a trigonometric function is proposed. Using this method, the characteristics of the laminar boundary layer on a wing profile or body of revolution can be determined for any velocity distribution at the external boundary of the layer. The agreement with Hartree's (1937) exact solution and Schubauer's (1935) experimental data for the separation point is superior to other approximate methods. V P

A71-34446 Approximate methods of constructing stream lines in meridional plane of blade nozzle annular cascades of steam and gas turbines in subsonic and supersonic flows. K. L. Yadao (Government Engineering College, Jabalpur, India) *Indian Journal of Technology*, vol. 9, Mar. 1971, p. 93-98. 5 refs.

Two approximate methods of constructing stream lines in the meridional plane of blade nozzle annular cascades of steam and gas turbines involving the use of the coefficient of velocity and the coefficient of mass flow are described. The basic aerodynamic parameters used were taken from the static aerodynamic experimental data obtained in subsonic and supersonic flows through the annular cascades with constant Reynolds' number. (Author)

A71-34447 Assessment of the anti-wear property of fuels under point contact conditions. N. Suresh, A. D. Tuteja, and P. K. Goel (Indian Institute of Petroleum, Dehra Dun, India) *Indian Journal of Technology*, vol. 9, Mar. 1971, p. 110-115.

The results of studies made under the point contact conditions obtainable in rigs like the 4-Ball m/c and the Ball and Cylinder m/c with the object of selecting suitable test parameters for assessing the wear protection (anti-wear) property of piston engine and aviation jet fuels are presented. It is concluded that the Ball and Cylinder test technique enables the assessment of the anti-wear properties of aviation jet fuels to a better degree of confidence than the 4-Ball test technique. The anti-wear property is not directly related to the viscosity, volatility or aromatic content of aviation jet fuels. (Author)

A71-34469 Concepts of fiber-resin composites. R. L. McCullough (Boeing Scientific Research Laboratories, Seattle, Wash.) New York, Marcel Dekker, Inc. (Monographs and Textbooks in Material Science. Volume 2), 1971. 122 p. 76 refs. \$8.50.

The main significance of this book lies in its direct approach to the fundamentals of composite materials, with emphasis on strength properties. The properties of typical materials for composites are

examined giving attention to fibers of glass, boron, and carbon, and to epoxy as matrix material. Elemental material candidates are Be, Mg, C, Si, Ti, N and O. Typical applications for composite materials include aircraft components such as compression panels, spoilers, fuselage stiffeners, and helicopter rotor blades. Composite properties are examined taking into consideration thermoelastic properties and tensile strength. The characteristics of the interphase region are investigated. G R

A71-34472 # Passenger plane power supply systems (Sistemy elektrosnabzheniia passazhirskikh samoletov). V. S. Zlochevskii (Moscow, Izdatel'stvo Mashinostroenie, 1971. 377 p. In Russian).

The power supply systems of 50 foreign (primarily U.S. and British) subsonic gas-turbine driven passenger planes of all classes are described, systematized, and analyzed. The trends in the development of power supply systems, and the influence of the aircraft characteristics and other aircraft systems on these trends is noted. Particular attention is given to the power supply systems of large airliners, such as the Boeing 747, and of short-haul aircraft, such as the Douglas DC-10 and the Lockheed L-1011. The book is intended for scientists and engineers, as well as students. V P

A71-34473 # Aircraft automatic control systems - Methods of analysis and design (Sistemy avtomaticheskogo upravleniia samoletom - Metody analiza i rascheta). I. A. Mikhalev, B. N. Okoemov, I. G. Pavlina, M. S. Chikulaev, and N. M. Eidinov (Moscow, Izdatel'stvo Mashinostroenie, 1971. 464 p. 22 refs. In Russian).

Methods of analyzing and calculating automatic control system parameters are discussed for a linear formulation of the problem. It is shown how the apparatus of linear theory makes it possible to assess, in the preliminary design phase, the capabilities of a simple control system for a specific plant, to determine the means of automation of flight control processes, and to derive the design characteristics of the autopilot from such analyses. Typical modes of operation of aircraft autopilots are examined, and the functions required from an autopilot are discussed. Much attention is given to the role of the human pilot in automatic flight control. The book is intended for engineers dealing with aircraft automatic control system design. V. P.

A71-34481 # Application of the low disc-loading prop rotor to a series of aircraft for the short-haul market. K. W. Sambell (Bell Helicopter Co., Fort Worth, Tex.) *American Institute of Aeronautics and Astronautics, Aircraft Design and Operations Meeting, 3rd, Seattle, Wash., July 12-14, 1971, Paper 71-781*. 15 p. 15 refs. Members, \$1.50, nonmembers, \$2.00.

It is shown that the interconnected shaft-driven low-speed lift-propulsion system based on four gimbal-propeller/rotors has potential for STOL aircraft with cruise speeds ranging from 250 to 500 knots. The same technology can be used to add VTOL aircraft to the short-haul system. The high propulsive efficiency at low speeds ensures minimum installed power and noise for any subsonic design cruise speed. The trend towards low disk-loading rotor systems and high aspect ratio wings requires careful attention to structural dynamics to ensure aeroelastic stability. Z W

A71-34482 The significance of an airport for the economy of its environment (Die Bedeutung eines Flughafens für die Wirtschaft in seiner Umgebung). Edgar Rossger, Klaus Haucke, Karl-Bernd Hunermann, and Erhard Jaden (Berlin, Technische Universität, Berlin, West Germany) *Nordrhein-Westfalen, Forschungsberichte*, no. 2082, 1970. 149 p. 39 refs. In German.

In an investigation, which takes into account theoretical models and empirical data, it was found that the effects produced by an airport are partly connected with its function as an enterprise and

partly with its function as an element of the air traffic system. The airport plays also an important part in the total national economy and its growth. Therefore, it is possible to employ the airports considered as an enterprise on the basis of investment decisions as an instrument for controlling the level of economic activity within the national economy. The airport is also a factor in determining the location of enterprises which maintain connections with foreign countries
G R

A71-34493 The room temperature fatigue behavior of nickel-base superalloy crystals at ultrasonic frequency. J K Tien and R P. Gamble (United Aircraft Materials Engineering and Research Laboratory, Middletown, Conn.) *Metallurgical Transactions*, vol 2, July 1971, p 1933-1938 19 refs

Using room-temperature tests on strain-rate insensitive nickel-base superalloy single crystals of Mar-M200, it is shown that the deleterious effect of environment is suppressed when the fatigue frequency is increased to the ultrasonic range. It was found that above a stress amplitude of 30,400 psi the fatigue lives of crystals ultrasonically fatigued in air increase with decreasing stress in a manner which is functionally similar to that of crystals conventionally fatigued in vacuum. These results indicate that the major effect of increasing the fatigue frequency of the ultrasonic range is in the suppression of the influence of oxygen in enhancing the rate of crack propagation
Z W.

A71-34498 Why maximum temperature. M E Naylor (General Motors Corp., Diesel Allison Div., Detroit, Mich.) and J L Byers (U S Naval Air Systems Command, Washington, D C.) *Society of Automotive Engineers, National Air Transportation Meeting, Atlanta, Ga., May 10-13, 1971, Paper 710461* 9 p. Members, \$1 00, nonmembers, \$1 50

The definition of a maximum temperature engine (MTE) is considered, and the particular characteristics that such an engine will provide for propulsion systems of future aircraft are discussed. It is shown that the MTE concept when properly employed to aircraft applications which can utilize its specific capabilities holds the promise of significant improvements in aircraft performance levels. An overview of some of the potential benefits is given by a comparison of one MTE with current development state-of-the-art engines
G.R

A71-34499 CAT II's role in low minimums. R H Noltemeir (FAA, Flight Standards Service, Washington, D C.) *Society of Automotive Engineers, National Air Transportation Meeting, Atlanta, Ga., May 10-13, 1971, Paper 710442* 3 p. Members, \$1 00, nonmembers, \$1 50

The actual Category II experience has been limited primarily because of problems associated with upgrading selected airports for Category II operations. Some of the considerations that have been taken into account in CAT II operations are discussed. Improved training in a number of areas can be accomplished by the use of additional training films and/or improved visual simulation. Aspects of an engine out missed approach are examined, and head-up displays are considered
G R

A71-34523 # Modeling for air traffic control systems. Amedeo R Odoni (MIT, Cambridge, Mass.). *Operations Research Society of America, Annual Meeting, 39th, Dallas, Tex., May 5-7, 1971, Paper 43* p 149 refs. Research supported by the U.S. Department of Transportation

In this paper we review several classes of models of Air Traffic Control-related systems that have been presented over the years. These models cover the complete spectrum of ATC activities: surface

traffic movement, runway utilization, terminal areas, and enroute traffic. Outstanding work in each area is summarized and criticized. The employed techniques range from the purely analytical to real and fast time simulations. Topics for possible future work are also identified on the basis of the present review. Finally, an extensive annotated bibliography is included
(Author)

A71-34525 # The evolution of the DC-10 wide-body tri-jet and its impact on air transportation. Robert E Hage (Douglas Aircraft Co., Long Beach, Calif.) *American Institute of Aeronautics and Astronautics, Aircraft Design and Operations Meeting, 3rd, Seattle, Wash., July 12-14, 1971, Paper 71-780* 19 p. Members, \$1 50, nonmembers, \$2 00.

Factors and considerations affecting the design features of the DC-10 aircraft during its development stage, starting in March 1966, are reviewed. In particular, attention is paid to sizing, determination of the optimum number of engines and optimum engine thrust, and selection of the cruise, approach, and stall speeds. Characteristics of both the medium-range DC-10 and the long-range DC-10-20 and DC-10-30 versions, which incorporate numerous innovations, such as spacious interiors, elimination of visible smoke, reduction of noise levels, increased performance parameters, etc., are discussed in detail.
O H

A71-34556 * Environmental effects on fatigue of structural materials for a supersonic transport. H. F. Hardrath (NASA, Langley Research Center, Fatigue Branch, Hampton, Va.) In: *Advanced testing techniques; American Society for Testing and Materials, Annual Meeting, 72nd, Symposium, Atlantic City, N.J., June 22-27, 1969, Proceedings*. Philadelphia, American Society for Testing and Materials (ASTM Special Technical Publication No 476), 1970, p 79-95 11 refs

Consideration of new design problems posed by SSTs which for solution require information on the mechanical behavior of new materials and on the effects of long exposure to elevated temperatures during service. Experimental studies of titanium alloys conducted at the NASA Langley Research Center are discussed. These studies define fatigue behavior, effects of temperature, rates of fatigue crack propagation, residual static strength, effect of aqueous environment on residual strength, the effect of outdoor exposure at elevated temperature, and behavior during simulated flights
F R L

A71-34590 # Gas turbine with a high velocity combustor. Boleslaw Szczeniowski. *Archiwum Budowy Maszyn*, vol 18, no 1, 1971, p 3-20

Study of a gas turbine consisting of a pure-impulse compressor, an isothermal burner, and a pure-impulse turbine. The point of the study is to demonstrate that the application of an isothermal burner makes it possible to either (1) reduce the maximum temperature of the turbine cycle without affecting the overall efficiency and specific work, or to (2) improve the overall efficiency and specific work without reducing the maximum temperature of the cycle. The term isothermal denotes that the temperature in the burner is kept as close to a selected constant value as possible. Performance curves of a gas turbine engine have been calculated for realistic process parameters in order to determine the optimal compressor pressure ratios
T M

A71-34597 # Influence of loading by linear radial forces on the stress state of a circular disk with a hyperboloidal profile (Wpływ obciążenia tarczy kołowej o profilu hiperboloidalnym liniowymi siłami promiennymi na jej stan naprężeń). Janusz Ziolkowski. *Archiwum Budowy Maszyn*, vol. 18, no. 2, 1971, p. 307-323. In Polish

Determination of the stress-strain distribution in a hyperboloidal-profile rotor disk loaded by linear radial forces

originated by the action of radial blades mounted along the circumference. The analyzed model of the disk is applicable to the rotor disks of aircraft-engine compressors with two-stream flow of the working medium. The proposed computational procedure permits numerical determination of stresses in the most highly loaded regions of the disk circumference near blade mountings. An analysis of the effects of various forms of loading makes it possible to design blade shapes from the viewpoint of obtaining disk stresses which do not exceed permissible values. A comparison of the results of two numerical examples illustrates a significant influence exerted by the hyperbolic shape of the disk profile. T M

A71-34601 Institute of Electrical and Electronics Engineers and Western Electronic Manufacturers Association, Western Electronic Show and Convention, Los Angeles, Calif., August 25-28, 1970, Proceedings. North Hollywood, Calif., Western Periodicals Co (WESCON Technical Papers Volume 14), 1970 680 p \$65

Topics include millimeter systems, LSI memories, active and passive filters, medical electronics, optoelectronic devices, and component manufacturing for the 70s. The optimizing selection of vacuum deposition equipment is discussed together with low-noise amplification problems at microwave frequencies, the integrated circuit overseas, the next generation of satellite systems, instrumentation for data acquisition and control systems, advances in commercial avionics, and instrumentation guidelines for the study and control of ecology and water pollution. Management control systems and management of the development of software systems, evaluation of proprietary software, minicomputers in process industries, and the impact of interactive computing systems on engineering problem-solving are considered. A permuted index is included.

Individual items are abstracted in this issue.

G.R

A71-34614 The next steps in ATC system modernization. Neal A. Blake (FAA, ATC Development Div., Washington, D.C.) In Institute of Electrical and Electronics Engineers and Western Electronic Manufacturers Association, Western Electronic Show and Convention, Los Angeles, Calif., August 25-28, 1970, Proceedings. North Hollywood, Calif., Western Periodicals Co (WESCON Technical Papers Volume 14), 1970, p. 17/1-17/14.

The ATC Advisory Committee to the Department of Transportation recommended that early increases in the capacity of the air transportation system be achieved by expanding existing urban airports, providing increased automation in the ATC system, implementing an improved landing system and upgrading the present data acquisition system. The functions of the improved system are discussed together with the interface between the ground automation and navigation systems and the associated equipment in the aircraft. Recommendations presented after an analysis of the collision situation are considered. It is pointed out that at the major high density airports of the 1980-1995 period the desired increase in capacity can only be achieved if an all-weather capability is provided.

G R

A71-34615 Implications of advanced avionics on airline operations. K. B. Olsen (American Airlines, Inc., Maintenance and Engineering Center, Tulsa, Okla.) In Institute of Electrical and Electronics Engineers and Western Electronic Manufacturers Association, Western Electronic Show and Convention, Los Angeles, Calif., August 25-28, 1970, Proceedings. North Hollywood, Calif., Western Periodicals Co (WESCON Technical Papers Volume 14), 1970, p. 17/2-17/27.

Studies pertaining to all aspects of air traffic control (ATC) are to be conducted. These studies involve not only an interim upgrading step for the 1980s, but projection toward total automation of ATC procedures by the 1990s. Approaches concerned with the avoidance of collision are considered, and the problem of clear air turbulence and its solution are examined. Other topics discussed include area

navigation, autopilots, airborne data acquisition, and the impact of new avionics advances on airline operations. Approaches for overcoming economic problems connected with the new developments are described. G.R

A71-34616 A precision area navigation system. John F. Gilbert and Allen G. Quynn (Boeing Co., Seattle, Wash.) In Institute of Electrical and Electronics Engineers and Western Electronic Manufacturers Association, Western Electronic Show and Convention, Los Angeles, Calif., August 25-28, 1970, Proceedings. North Hollywood, Calif., Western Periodicals Co (WESCON Technical Papers. Volume 14), 1970, p. 17/3-17/316.

Each vehicle in the system considered would be able to maintain a continuous and precise estimate of its position and velocity in three dimensional space on any chosen path. As a result of continuous, precise knowledge of position and velocity, the time at which the aircraft passes various way points could be controlled quite accurately. Components in a precision navigation system include a physical inertial platform and external radio data sources, the navigation computation, and the filter or mixing computations. A simulation program written in Fortran IV and a number of simulation test cases are discussed. G.R

A71-34617 Airborne display and electric management system. Robert C. Eckenfelder (Bendix Corp., Electric Power Div., Eatontown, N.J.) In Institute of Electrical and Electronics Engineers and Western Electronic Manufacturers Association, Western Electronic Show and Convention, Los Angeles, Calif., August 25-28, 1970, Proceedings. North Hollywood, Calif., Western Periodicals Co (WESCON Technical Papers Volume 14), 1970, p. 17/4-17/45.

The system goals include aircraft weight reduction, improved protective function coordination, improved power quality, decreased onboard maintenance, presentation of processed data for more effective crew action, and increased reliability. The system contains two 1000-channel circuit breaker multiplex systems and 200 remote control circuit breakers with solid-state sensing. The circuit breakers include single-phase ac, three-phase ac, and dc circuit breakers, 200 switch indicator modules, two keyboard controls, one cathode ray tube display, one general purpose processor, one control console, two 40-channel parameter sensing and digitizers, and one data multiplex system. G R

A71-34659 # Vortex shedding from a turbulent jet in a cross-wind. H. M. McMahon, D. D. Hester, and J. G. Palfrey (Georgia Institute of Technology, Atlanta, Ga.) *Journal of Fluid Mechanics*, vol. 48, July 13, 1971, p. 73-80. 11 refs. Grant No. DA-HC-04-68-0004.

The flow visualization and quantitative hot-wire measurements presented show that vortex shedding is associated with a turbulent air jet issuing at 90 degrees from a flat plate into a cross-wind. Results for circular slot jets are presented. Tests show that a splitter plate stops vortex shedding as in the solid body case. A possible method of reducing the lift loss associated with the jet-cross-wind interaction is suggested on the basis of the test results. The experiments were conducted in the 9 ft subsonic wind tunnel at the Georgia Institute of Technology. Free-stream velocity for most of the tests was 50 ft/sec, corresponding to a Reynolds number of 26,000 per inch. G R

A71-34674 # A uniformly asymptotic solution for incompressible flow past thin sharp-edged aerofoils at zero incidence. A. F. Sheer (Royal Holloway College, Englefield Green, Surrey, England) *Cambridge Philosophical Society, Proceedings*, vol. 70, July 1971, p. 135-155. 9 refs.

A difficulty is considered in the theory of inviscid incompressible flow past thin airfoils, in which an expansion for the complex potential or complex velocity is sought in powers of the thickness ratio. It is then found that such an expansion breaks down in the vicinity of the airfoil edges. At sharp edges, the method of matched asymptotic expansions fails to remedy this. This failure is explained, and, in the case of incompressible flow past a symmetric airfoil at zero incidence, it is shown that by proper choice of the dependent variable an expansion may be obtained which is uniformly asymptotic. Finally, the case of a circular-arc airfoil is considered in greater detail. M V E

A71-34680 Time division multiplex system for air traffic control (Système de multiplex temporel pour la gestion de trafic aérien). G Bomont, R Douillet, M Plantier (Direction de la Navigation Aérienne, Paris, France), P Bréant, G David, and M Duquenne (Télécommunications Radioélectriques et Téléphoniques, Paris, France) (*Société Française des Electroniciens et des Radioélectroniciens, Colloque International sur l'Espace et la Communication, Paris, France, Mar. 29-Apr. 2, 1971*) *L'Onde Electrique*, vol 51, June 1971, p. 466-478. 11 refs. In French.

Results of studies undertaken in France for the control of air traffic in regions where installations are impractical (oceans, polar regions). Air transportable models were developed with the intent to verify the feasibility of telecommunications and surveillance geostationary satellites. The system comprises a single multiplex in the earth-aircraft sense, and two multiplexes in the inverse sense. The characteristics of these multiplexes, which make use of numerical techniques, are briefly described, followed by definition of the techniques adopted, with emphasis on the aircraft equipment. The results obtained in the course of laboratory experiments or from simulations show the validity of the solutions retained, in particular that of delta modulation for the numerical transmission of voice signals. F R L

A71-34681 The on-board antenna of the Dioscures system

Application of electronic scanning to air navigation by satellites (L'antenne Je bord du système Dioscures - Application du balayage électronique à la navigation aérienne par satellites). B Dorier (SNECMA, Suresnes, Hauts-de-Seine, France) (*Société Française des Electroniciens et des Radioélectroniciens, Colloque International sur l'Espace et la Communication, Paris, France, Mar. 29-Apr. 2, 1971*) *L'Onde Electrique*, vol 51, June 1971, p. 479-485. 6 refs. In French.

Description of the telecommunications system for air traffic control and navigation by the Dioscures satellites which is based on the establishment of band L links between commercial aircraft and two stationary satellites. Electronic scanning makes possible an independent orientation of two antenna beams, using a fixed apparatus of small size consisting of two antennas, the associated control box, and the computer unit which controls the orientation of the beams as a function of the aircraft position. The various subassemblies and the results obtained are described. A simulation test was carried out to verify the good operation of the electronic scanning system. F R L.

A71-34700 Automatic control of aircraft electrical system reduces wiring and improves reliability. Manvel A Geyer (Westinghouse Electric Corp., Aerospace Electrical Div., Lima, Ohio) and Dwayne F Rife (Westinghouse Research and Development Center, Pittsburgh, Pa.) *Westinghouse Engineer*, vol 31, July 1971, p. 114-119.

In the new automatically controlled electrical system, both control wiring and power wiring are minimized. Control and indication signals are transmitted between the cockpit and a number of remote power controllers via remote input/output units and a multiplexed data bus. The distribution control center is a 'switch-

board' for properly routing signals between control and indication devices. Limit switches and other mechanical relay devices are replaced by transducers that provide signals to the distribution control center, where the logic for sequencing and automatic control is continued. Switch-indicator modules provide one means of trip and load indication as well as manual command input. Z'W

A71-34792 # Pressure changes as boundary layer effects in the tube wind tunnel (Druckänderungen als Grenzschichteffekte im Rohrwindkanal). Eckart Piltz. Darmstadt, Technische Hochschule, Fakultät für Maschinenbau, Dr.-Ing. Dissertation, 1971. 97 p. 17 refs. In German.

Measurements in a tube wind tunnel were conducted in order to verify the theoretical conclusions reported by Becker (1957, 1958). It was also tried to find an approach for representing the pressure drop in a general way in a form making use of an effective resistance parameter. The possibility to simplify the theory by a systematic linearization involving the Mach number $M_{sub} 1$ was also investigated. Satisfactory agreement between Becker's theory and the experimental results was obtained in the case of developed pipe flow. There were, however, certain systematic differences between theory and experimental results during the time interval of growing boundary layers. Various assumptions of the theory were, therefore, examined, and modified. It was possible to adapt the theory in such a way that a satisfactory agreement between theoretical and experimental values was obtained. G R

A71-34850 # The problem of protecting flight vehicles from icing (K voprosu o zashchite letatel'nykh apparatov ot obledeneniia). A. G Bodrik and V. A Pavlov. *Vychislitel'naia i Prikladnaia Matematika*, no. 12, 1970, p. 138-141. In Russian.

Consideration of a one-dimensional Stefan problem concerning the melting of a layer of ice on the surface of a flight vehicle during the operation of a cyclic deicing system. The investigated problem (with boundary conditions of the third kind) is solved analytically by means of Sokolov's (1967) method of averaging functional corrections. A B K

A71-34874 * # Optimization of complex structures to satisfy flutter requirements. Carl S Rudisill (Clemson University, Clemson, SC) and Kumar G Bhatia. *AIAA Journal*, vol 9, Aug 1971, p. 1487-1491. 7 refs. Grant No. NGR-41-001-027.

Equations for finding the partial derivatives of the flutter velocity of an aircraft structure with respect to structural parameters are derived. A numerical procedure is developed for determining the values of the structural parameters such that a specified flutter velocity constraint is satisfied and the structural mass is a relative minimum. A search procedure is presented which utilizes two gradient search methods and a gradient projection method. The procedure is applied to the design of a box beam. (Author)

A71-34884 # Computation of incompressible turbulent boundary layers at low Reynolds numbers. Tuncer Cebeci and G J Mosinskis (Douglas Aircraft Co., Long Beach, Calif.) *AIAA Journal*, vol 9, Aug 1971, p. 1632-1634. 7 refs. Contract No. N00014-70-C-0099.

A method is presented by which the eddy-viscosity and mixing-length concepts, that are being used in the current differential methods, can be modified to calculate incompressible turbulent boundary layers at low Reynolds numbers. A comparison of several calculated results using this modification shows good agreement with experiment. O H

A71-34887 # Absolute velocity determination in a hypersonic low-density flow. K A Butefisch (Aerodynamische Versuchsanstalt, Göttingen, West Germany) *AIAA Journal*, vol 9, Aug. 1971, p 1639, 1640.

Investigations have been conducted in a hypersonic low-density wind tunnel to obtain an accurate knowledge of the absolute flow density. For this purpose, a method was employed which was based on time-of-flight measurements of nitrogen ions produced by a short pulsed high-energy electron beam. The results of the time-of-flight velocity measurements are given graphically and discussed. O H

A71-34889 # Vortex flow over a flat surface with suction. Kenichi Nanbu (Tohoku University, Sendai, Japan) *AIAA Journal*, vol 9, Aug 1971, p 1642, 1643 10 refs

Boundary-layer equations have been solved for steady incompressible flow with a potential vortex as the outer flow over an infinite flat surface under the boundary condition of distributed suction. It is shown that, without any speculation to the singularity on the vortex axis, a formal similarity solution can be obtained for suction parameter greater than a certain value. O H

A71-34890 # Shock and vibration isolation using a nonlinear elastic suspension. T E Shoup (Rutgers University, New Brunswick, N.J.) *AIAA Journal*, vol 9, Aug 1971, p 1643-1645 8 refs. Research supported by Rutgers University.

Information is presented for use in the design of nonlinear 'elastica' suspension springs with symmetrically hardening behavior which are promising as a shock and vibration isolation mount, particularly in the aerospace and transportation industries. Suspension dynamics of this suspension system is examined theoretically, the resulting frequency response, obtained numerically, is shown graphically and discussed. O H

A71-34895 # Shock standoff distances and Mach-disk diameters in underexpanded sonic jets. W Davidor and S S Penner (California, University, La Jolla, Calif.) *AIAA Journal*, vol 9, Aug 1971, p 1651-1653 9 refs. Contract No AF 44(620)-68-C-0010

Experimental measurements were performed in a blow-down tunnel with mixtures of nitrogen dioxide and nitrogen tetroxide as working fluid. Standoff distances were determined photographically by using a movie camera. The previously published data on Mach-disk diameters have been replotted in a graph, together with experimental results for nitrogen and for the reacting system consisting of nitrogen dioxide and nitrogen tetroxide. G R

A71-34898 # Separation of a supersonic accelerated flow over notches. A F Charwat (California, University, Los Angeles, Calif.) *AIAA Journal*, vol 9, Aug 1971, p 1656, 1657

Wind tunnel experiments have been conducted to determine the effect of a negative pressure gradient - i.e., freestream acceleration - on supersonic flow over rectangular notches 0.5 and 1 in. deep with variable lengths. The Mach number immediately ahead of separation was 1.81. Results are presented graphically, compared to those obtained theoretically, and found to be in good agreement. O H

A71-34899 # Mechanism of entrainment in turbulent wakes. P M Bevilacqua and P S Lykoudis (Purdue University, West Lafayette, Ind.) *AIAA Journal*, vol 9, Aug 1971, p 1657-1659 5 refs

The nature of the flow near the interface between the laminar and turbulent regions and the still unresolved problem of how the turbulence spreads are examined. A wake model is suggested which explains the character of entrainment. O H

A71-34900 # Flowfield produced by trailing vortices in the vicinity of the ground. J K Harvey (Imperial College of Science and Technology, London, England) and F J Perry *AIAA Journal*, vol 9, Aug 1971, p 1659, 1660

The influence of the ground during the takeoff and landing phases of aircraft on the behavior of aircraft trailing vortices is examined. In particular, the observed departure of the vortices from the theoretical path by rising again after having descended close to the ground is experimentally tested to qualitatively determine the cause of this phenomenon. Results are given graphically and discussed. O H

A71-34902 # Laminar convective heat-transfer rates on a hemisphere cylinder in rarefied hypersonic flow. David E Boylan (ARO, Inc., von Kármán Gas Dynamics Facility, Arnold Air Force Station, Tenn.) *AIAA Journal*, vol 9, Aug 1971, p 1661-1663 7 refs

Experimental results are presented for the stagnation point heat-transfer rate and the heat-transfer rate distribution over a hemisphere cylinder in hypersonic, rarefied flow. Comparison is made with the higher-order theories of Cheng (1961) and Davis (1970) for the stagnation point heat-transfer rate and the theory of Lees (1956) for the heat transfer rate distribution. O H

A71-35023 On estimating the aerodynamic damping of the vibrations in turbine vanes. G S Samoilovich, V V Nitusov, and A A Sidorov (*Problemy Prochnosti*, vol 2, Sept 1970, p 98-100.) *Strength of Materials*, Sept 1970, p 942-944. Translation

Derivation of a procedure for calculating the levels of oscillation damping by aerodynamic forces in turbine blades of aircraft engines. The procedure is based on a method proposed by the authors (1968) for calculating the parameters of an array of arbitrary profiles vibrating with arbitrary phase shifts in a plane incompressible fluid flow. V Z

A71-35070 # The integrated avionics systems exercise in the RAE Comet 4. J G Carr (Royal Aircraft Establishment, Farnborough, Hants., England) In: Institute of Navigation, National Space Meeting on Space Shuttle - Space Station - Nuclear Shuttle Navigation, NASA Marshall Space Flight Center, Huntsville, Ala., February 23-25, 1971, Proceedings. Washington, D C, Institute of Navigation, 1971, p 405-418

Description of the installation and experimental program of the Comet 4 aircraft which is being fitted out as a flying laboratory at the RAE Farnborough, UK. One of the main tasks in this aircraft will be to investigate the techniques necessary for the integration of avionics systems. The navigation system lends itself more readily than most to integration and will be studied in the early experiments. Besides the investigation of the use of digital computers and digital techniques, the work will include research and development in computer controlled displays such as 'projected map' and cathode ray tube displays, and in digital data transmission both along conventional cables and along fiber optic links. The operation of the multifunction keyboard and cathode ray tube displays is described. M M.

A71-35097 Characteristics of satellite-to-aircraft links. Howard C Salwen (Signatron, Inc., Lexington, Mass.) In: Institute of Electrical and Electronics Engineers, Annual International Conference on Communications, 7th, Montreal, Canada, June 14-16, 1971, Proceedings. Edited by H L Blacker. New York, Institute of Electrical and Electronics Engineers, Inc. (ICC Conference Record Volume 7), 1971, p 29-14 to 29-18 16 refs

The propagation characteristics of satellite-to-aircraft links are reviewed, and estimates of channel parameters are given. A general method for describing the multipath on such links is presented. The

characteristics of specular reflected signals are described, and aspects of diffuse scattering are investigated. The computation of the scattering function is discussed. Characteristics of the diffuse multipath include specification of the relative delay and Doppler. The characteristics of the multipath are further characterized by the delay spread, and the fading bandwidth. Approaches for studying ionospheric effects are considered. G R

A71-35106 **A queueing theory approach to communication satellite network design.** Herbert G. Raymond (TRW Systems Group, Redondo Beach, Calif.) In: Institute of Electrical and Electronics Engineers, Annual International Conference on Communications, 7th, Montreal, Canada, June 14-16, 1971, Proceedings. Edited by H. L. Blacker. New York, Institute of Electrical and Electronics Engineers, Inc. (ICC Conference Record Volume 7), 1971, p. 42-26 to 42-31. 6 refs.

The increasing use of communication satellites has led to rising interest in networks that best exploit the unique capabilities of satellite repeaters. Utilizing the techniques of queueing theory, the behavior of two useful satellite networks is analyzed. First, a single multichannel node is used to model an Oceanic Air Traffic Control System. This model was employed not only to calculate the required satellite capacity, but also to determine its sensitivity to the traffic assumptions. Next, the model was extended to a multinode network representing a worldwide military broadcast communication system. The behavior of this network was then examined for varying traffic patterns. This parametric analysis identified key network design parameters and suggested several useful design guidelines. (Author)

A71-35151 **Damage tolerance in aircraft structures, American Society for Testing and Materials, Annual Meeting, 73rd, Symposium, Toronto, Canada, June 21-26, 1970, Proceedings.** Philadelphia, American Society for Testing and Materials (ASTM Special Technical Publication No. 486), 1971. 258 p. \$19.50.

The articles provide information on the growth of cracks in engineering structures and the residual strength of cracked structures for the purpose of predicting service lives of structures subjected to fatigue loading and to establish safe inspection intervals. Basic concepts in fatigue crack propagation, the effects of panel geometry, the influence of panel stiffeners, and the application of fracture mechanics and crack propagation to the design and testing of aircraft structures are dealt with. Ballistics damage characteristics and tolerance are also discussed.

A B K

A71-35153 **Effect of thickness on the fracture toughness of 7075 aluminum in the T6 and T73 conditions.** F. C. Allen (Douglas Aircraft Co., Long Beach, Calif.) In: Damage tolerance in aircraft structures, American Society for Testing and Materials, Annual Meeting, 73rd, Symposium, Toronto, Canada, June 21-26, 1970, Proceedings. Philadelphia, American Society for Testing and Materials (ASTM Special Technical Publication No. 486), 1971, p. 16-38. 5 refs. Research sponsored by the Douglas Aircraft Independent Research and Development Program.

The test program was conducted on 60 centrally cracked specimens varying in thickness from 0.05 to 0.75 in. Analysis of the results showed that the two materials displayed substantially different characteristics. This is attributed to the fact that, owing to the low proportional limit of the T73 material, the net section stress was in the plastic range for most specimens, whereas for the T6 material the net section stress was always in the elastic range. It was noted that during slow crack growth, the crack grew faster in the center than at the surface of the material. A lumped parameter, redundant force analysis of three plates of varying thickness was made. The results show the development of plane strain conditions with increased thickness. Z W

A71-35156 * **Fatigue crack propagation in stiffened panels.** C. C. Poe, Jr. (NASA, Langley Research Center, Fatigue Branch, Hampton, Va.) In: Damage tolerance in aircraft structures, American Society for Testing and Materials, Annual Meeting, 73rd, Symposium, Toronto, Canada, June 21-26, 1970, Proceedings. Philadelphia, American Society for Testing and Materials (ASTM Special Technical Publication No. 486), 1971, p. 79-97. 6 refs.

Rates of fatigue crack growth were measured in fatigue tests of stiffened panels constructed with bolted and integral stringers. The panels with bolted stringers were made from 2024-T3 aluminum alloy sheet with either aluminum alloy or steel stringers. The stringers were attached to the sheet with interference fit lock bolts. Stringer spacing and stiffness were varied systematically in the construction of the panels. The integrally stiffened panels were made from 7075-T6 aluminum alloy sheet extruded with outstanding stringers. The stress intensity factor, calculated by a previously developed method, is used to predict the crack growth rates for the stiffened panels. Fatigue tests were conducted on unstiffened panels to determine the relationship between the stress intensity factor and crack growth rate. In general, the stress intensity factor correctly predicts the crack growth rates in panels with bolted and with integral stringers except when the cracks are long. In these cases, the measured rates are slightly higher than the predicted rates. Furthermore, the stress intensity factor correctly predicts the rates to be lower in the panels with stiffer and more closely spaced stringers and to be equal in panels with steel and with aluminum alloy stringers of equal stiffness. The bolted stringers reduced the crack growth rate significantly below that for an equally stressed unstiffened panel, whereas the integral stringers had no significant effect. (Author)

A71-35157 **Material toughness and residual strength of damage tolerant aircraft structures.** A. F. Liu and J. C. Ekvall (Lockheed-California Co., Burbank, Calif.) In: Damage tolerance in aircraft structures, American Society for Testing and Materials, Annual Meeting, 73rd, Symposium, Toronto, Canada, June 21-26, 1970, Proceedings. Philadelphia, American Society for Testing and Materials (ASTM Special Technical Publication No. 486), 1971, p. 98-121. 15 refs.

Fracture tests were conducted on precracked panels reinforced with various crack stoppers. Motion pictures and continuous graphical records of load and local strains were taken during the tests. The purpose of these tests was to study variables affecting residual strength of reinforced panels. Results show that, for 2024-T3 aluminum skin panels reinforced with riveted or bonded flat straps made of various alloys, the residual strength increases with the product of reinforcement area and reinforcement strength. Reinforcement stiffness, which is of primary importance for other classes of panel configurations, was found not to be a significant variable for the panel configurations tested. A crack opening displacement model is proposed to illustrate the influence of the reinforcements, the skin fracture toughness, and the slow stable tear characteristics on the arrest of a stably propagating crack. The model helps to elucidate the interactions between skin variables and reinforcement variables. (Author)

A71-35159 **Initiation and growth of fatigue cracks in and residual strength of the F-100 wing.** W. D. Graziano and G. E. Fitch, Jr. (North American Rockwell Corp., Los Angeles, Calif.) In: Damage tolerance in aircraft structures, American Society for Testing and Materials, Annual Meeting, 73rd, Symposium, Toronto, Canada, June 21-26, 1970, Proceedings. Philadelphia, American Society for Testing and Materials (ASTM Special Technical Publication No. 486), 1971, p. 144-163. 11 refs. Contract No. AF 04(606)-14942.

Full scale fatigue tests were conducted on the F-100 wing. Service connected fatigue failure data were collected and compared with test results. Test lives to initiate fatigue cracks are compared with predicted lives using Miner's rule of linear cumulative damage.

and by a method accounting for plasticity at the crack origin. Calculated failure stresses using the principles of fracture mechanics are compared with laboratory test failure data. Crack growth data measured during testing are compared with values predicted from the relation dl/dN vs ΔK , the range in the stress intensity factor. Modifications to the wing structure are described, and the resulting fatigue life improvement is presented. (Author)

A71-35160 Development of the fail-safe design features of the DC-10. T. Swift (Douglas Aircraft Co., Long Beach, Calif.) In *Damage tolerance in aircraft structures*, American Society for Testing and Materials, Annual Meeting, 73rd, Symposium, Toronto, Canada, June 21-26, 1970, Proceedings Philadelphia, American Society for Testing and Materials (ASTM Special Technical Publication No. 486), 1971, p. 164-214. 15 refs.

The degree of damage tolerance used in the design of the DC-10 fuselage pressure shell is discussed with reasons for its selection. Analysis methods are presented for the prediction of the residual strength of damaged, stiffened panels, based on the matrix force solution of an idealized structure combined with fracture mechanics equations. The results of 20 different configurations are included. A description of the development test program to verify the analytical techniques and to substantiate the fail-safe strength of the fuselage shell is given together with the results for many of the tests. (Author)

A71-35161 The ballistic damage characteristics and damage tolerance of wing structural elements. J. E. Jensen (General Dynamics Corp., Convair Div., San Diego, Calif.) In *Damage tolerance in aircraft structures*, American Society for Testing and Materials, Annual Meeting, 73rd, Symposium, Toronto, Canada, June 21-26, 1970, Proceedings Philadelphia, American Society for Testing and Materials (ASTM Special Technical Publication No. 486), 1971, p. 215-229.

The damage and residual strength of 7075-T6 aluminum panels exposed to caliber 0.50 AP M2 gunfire was found to vary with projectile velocity, impact angle, and target thickness. Maximum damage occurred at low velocities and high impact angles. The strength of thin panels agreed closely with fracture theory because of their predominant cracklike flaws; conversely, the strength of thick panels was close to the material ultimate tensile strength because of the blunt flaw shapes. Damage and residual strength prediction models were developed from the test data for monolithic panels. Alternate design concepts consisting of laminated, planked, and spar cap stiffened panels were investigated. The laminated panels exhibited extensive petaling and star-type cracking and low residual strength. Planked and spar cap stiffened panels provided damage alleviation and crack arrestment with high preload stresses. (Author)

A71-35163 Crack propagation in helicopter rotor blades. M. J. Rich (United Aircraft Corp., Sikorsky Aircraft Div., Stratford, Conn.) In *Damage tolerance in aircraft structures*, American Society for Testing and Materials, Annual Meeting, 73rd, Symposium, Toronto, Canada, June 21-26, 1970, Proceedings Philadelphia, American Society for Testing and Materials (ASTM Special Technical Publication No. 486), 1971, p. 243-251. 7 refs.

Design criteria are presented for the residual strength and life of fatigue loaded helicopter structures. The crack propagation rate methods and data are reviewed, and a bilinear semilog method is shown to be most accurate for predicting residual life. The methods developed are compared with full scale rotor blade fatigue data. The good correlation with test data demonstrates the value of fracture mechanics analysis for fail-safe design. (Author)

A71-35194 # Air transport 1969 (Vozdushnyi transport 1969). I. I. Pil'chman and V. I. Nozdryn. Moscow, Izdatel'stvo VINITI, 1970. 104 p. 112 refs. In Russian.

The development of air traffic control systems and air transport automatic landing systems in the U.S. and Western Europe is summarized. Information display systems are described, as well as automated air traffic control systems and various electronic devices for controlling air traffic. The present state of development of automatic landing systems is reviewed, automatic landing systems produced in Great Britain, the U.S., and France are evaluated, and certain helicopter and V/STOL landing systems are investigated. The automation of air traffic after landing and while taxiing on the airfield is considered. A B K

A71-35202 # Structural applications of high modulus graphite composites. E. L. Sward. In *Composite materials and structures*, Society for Experimental Stress Analysis, Annual Solid Mechanics Symposium, 4th, U.S. Air Force Academy, Colorado Springs, Colo., May 7, 1971, Proceedings. Symposium co-sponsored by the Dow Chemical Co., the Kaman Sciences Corp., and the Martin Marietta Corp., Denver, Society for Experimental Stress Analysis, 1971. 23 p. 8 refs.

Description of two actual applications in which high-modulus graphite composites provided a lighter functional structure than is obtainable from alternate materials. The first, a stiffness-critical horizontal stabilizer for a supersonic aircraft, used a high-modulus graphite composite for maximum weight savings (about 50%) without loss of necessary structural strength. The other application of composites in a spacer assembly clearly demonstrates the advantages of using materials efficiently, a high-modulus graphite composite is used where stiffness is important, and high-strain materials are used where the modulus is not so critical. An overall 60% weight reduction was obtained in this case. Z W

A71-35208 The art of selecting aircraft. M. A. Guinane and Charles Martin (Caledonian-British United Airways, Ltd., London, England). *Shell Aviation News*, no. 396, 1971, p. 2-7.

Use of the concept that long haul international air transport is more economic than any other type of airline operation as a basis for selecting aircraft. Because of the very large amount of money involved, the choice made must be the right one. Each evaluation exercise is broken down into six stages: environment, initial selection, operational study, budgetary study, policy review, and final decision. It occasionally happens that a second or even a third choice must ultimately be selected because of, among other reasons, financing arrangements, better sales appeal, or problems of foreign exchange control. F R L

A71-35210 Soft-ground arresting of civil aircraft. E. Bade (Royal Aircraft Establishment, Farnborough, Hants., England). *Shell Aviation News*, no. 396, 1971, p. 14-21.

Study of the merits of soft ground material, such as gravel and fuel ash pellets, for safely decelerating aircraft that overshoot the runway during takeoff and landing. Tests carried out with actual aircraft and with scale models showed that soft-ground arresters can increase safety margins in that they can arrest or slow down aircraft with a minimum of damage at moderate cost. F R L

A71-35237 # A review of the propagation work at BRS. W. E. Scholes (Department of Environment, Building Research Station, Watford, Herts., England). *British Acoustical Society, Acoustic, Atmospheric, Propagation and Applications Meeting, University College, London, England, June 30, 1971, Paper 3 p.* 7 refs.

Short review of the main features and results of the recurrent experimental research efforts applied at the Building Research Station since 1954 to the investigation of outdoor sound propagation.

for the purpose of building design guidance in relation to aircraft and road traffic noise. Experiments have covered vertical and oblique sound propagation from aircraft in flight, nearly horizontal propagation from a small range of source heights, and performance assessment of noise barriers. Briefly outlined are also the local background to the experiments, some of the techniques employed, and a few of the ways in which findings have been applied. M.V.E

A71-35259 **Interaction of radiation with the boundary layer at the stagnation point.** S. Ia. Bronin (Akademiya Nauk SSSR, Nauchno-Issledovatel'skii Institut Vysokikh Temperatur, Moscow, USSR) (*Teplofizika Vysokikh Temperatur*, vol 8, Nov.-Dec. 1970, p. 1138-1141) *High Temperature*, vol 8, Nov.-Dec. 1970, p. 1069-1072 Translation.

A simple approximate relation is established between the convective flow at the critical point and the decrease in the radiation flux as a result of absorption in a cold boundary layer. In particular, it follows from this relation that when there is no flow in the boundary layer of surface-destruction products, the total heat flow (radiative plus convective) is essentially independent of the optical properties of the gas in the boundary layer (Author)

A71-35279 **Stagnation pressure changes in unsteady flow.** J. H. Horlock and H. Daneshyar (Cambridge University, Cambridge, England) *Aeronautical Quarterly*, vol 22, Aug 1971, p. 207-224 11 refs

The changes in stagnation pressure produced by movement of rows, arrays and sheets of vortices are derived. By applying Preston's result for a single row of moving vortices to continuous vortex sheets, the time mean stagnation pressure downstream of a row of blades with fluctuating circulation is derived. It is shown that if the blade circulation varies due to the potential flow fields of the neighboring blades then the time mean stagnation pressure may change with location (Author)

A71-35280 **Experimental results for waveriders in certain off-design conditions.** L. C. Squire (Cambridge University, Cambridge, England) *Aeronautical Quarterly*, vol 22, Aug 1971, p. 225-232 11 refs

For caret waveriders at the design condition the attached shock wave in the plane of the leading edges may correspond to either a strong or a weak oblique shock wave when viewed normal to the edges. In cases when the design shock wave corresponds to the strong oblique shock the off-design behavior of the wing is not completely understood. In this note some measured results are analyzed in an attempt to understand this off-design behavior (Author)

A71-35281 **Numerical calculations of the hypersonic viscid-inviscid flow inside simple ducts of circular cross-section.** B. H. K. Lee (National Aeronautical Establishment, Ottawa, Canada) *Aeronautical Quarterly*, vol 22, Aug 1971, p. 233-256 14 refs

The method of characteristics and an implicit finite-difference scheme are used to investigate the interaction between the internal flowfield and laminar boundary layer in ducts of circular cross section under conditions of high Mach number and low Reynolds number. The displacement thickness is added on to the body to form a new 'effective body shape' which is used to recalculate the inviscid flow. Iterations are performed, and a solution is obtained when the surface pressures in two consecutive iterations converge to within a specified tolerance. The results are computed for constant wall temperature. The type of shock-wave interaction near the axis of symmetry is determined and the computation terminates after the fluid properties behind the reflected shock have been calculated

M V E

A71-35282 **Vibration characteristics of pre-twisted blades of asymmetrical aerofoil cross-section.** W. Carnegie and B. Dawson (Surrey, University, Guildford, Surrey, England) *Aeronautical Quarterly*, vol 22, Aug 1971, p. 257-273. 11 refs

The natural frequencies and mode shapes of vibration of cantilever aerofoil cross-section blades of pre-twist angle in the range 0 to 90 deg are obtained. The beams are 152.4 mm long and the width/thickness ratio is such that they may be regarded as slender. Theoretical frequency ratios and mode shapes of vibration, neglecting shear and rotary inertia effects, are obtained for two sets of beams, one with clockwise pre-twist relative to the root cross-section and the other with anti-clockwise pre-twist. The effect of variation in the value of the center-of-flexure coordinates upon the natural frequency ratios and mode shapes of vibration is investigated. The theoretical results are compared to corresponding experimental results (Author)

A71-35285 **Gust loading on a thin aerofoil.** B. D. Mugridge (Southampton, University, Southampton, England) *Aeronautical Quarterly*, vol 22, Aug 1971, p. 301-310

Derivation of a closed-form expression which gives an approximate solution to the lift generated on a two-dimensional thin airfoil in incompressible flow. The inaccuracy of the solution when compared with other published work is compensated by the simplicity of the final expression, particularly if the result is required for the calculation of the sound power radiated by an airfoil in a turbulent flow (Author)

A71-35286 # **Measurement of very small displacements using holographic interferometry.** C. J. Kramer and W. A. Shapiro (Bendix Corp., Navigation and Control Div., Teterboro, N.J.) *Bendix Technical Journal*, vol 4, Spring 1971, p. 1-6 Navy-supported research

The interpretation of interferometric fringe patterns can be a complicated process, but the single underlying relationship that governs the pattern is relatively simple. A few observations concerning this relationship lead to certain approaches that improve both the threshold and the resolution of the holographic method. One such approach is described in this paper, along with the results of interferometric measurements made to determine the stability of a precision gyro. The principle of interference is reviewed briefly, and the relevant characteristics of the holographic image are discussed

(Author)

A71-35300 **Tapered roller bearings take off.** Robert F. Cornish (Timken Co., Canton, Ohio) and James J. Benes *Machine Design*, vol 43, July 22, 1971, p. 65-67.

Outline of lubrication techniques that may enable bearings to operate at more than twice their present speed and still have their inherent ability to carry heavy loads. Such bearings find application for helicopter transmissions, since there is a weight saving and the statistical reliability of two bearings is much greater than that of three bearings. By redirecting the lubricant flow through the bearing or by introducing a second source of lubricant directly to the critical contact area, tapered roller bearings can be run at speeds up to 20,000 fpm cone velocity. Test results on a CH-47 Boeing helicopter transmission are discussed

F R L

A71-35301 **Strength and stability of thin-walled aircraft structures (Prochnost' i ustoychivost' tonkostennykh aviatsionnykh konstruktstii).** Edited by I. F. Obraztsov. Moscow, Izdatel'stvo Mashinostroenie (Moskovskii Aviatsionnyi Institut, Trudy, No 180), 1971. 299 p. In Russian.

A study is made of the strength of plates and shells of aircraft structure type under various types of loading. The calculation and

design of optimal structures, and methods of calculating and analyzing the strength of shells of revolution made of composite materials are presented. Problems involving general and local loss of stability of multilayer structures are investigated, taking into account the filler rigidity

Individual items are abstracted in this issue

A B K

A71-35312 # Investigation of aircraft structural panels under repeated static loads (Issledovanie panelei aviatsionnykh konstruktii pri povtorno-staticheskikh nagruzheniyakh). E P Obolenskii and B I Sakharov. In: Strength and stability of thin-walled aircraft structures (Prochnost' i ustoychivost' tonkostennykh aviatsionnykh konstruktii). Edited by I F Obraztsov. Moscow, Izdatel'stvo Mashinostroenie (Moskovskii Aviatsionnyi Institut, Trudy, No 180), 1971, p 173-193 19 refs. In Russian.

A procedure for mathematically processing structural fatigue data, using methods in probability theory, mathematical statistics, and correlation and regression analysis. The results obtained by this method for various panels are used to study the influence of technological and structural factors on the fatigue life of airframe panels. General relations for calculating the endurance of panels under cyclic loading are proposed.

V P.

A71-35313 # Constrained torsion of an incompletely fastened spar box (Stesennoe kruchenie kessona pri nepolnoi zadelke). G Ia Abramova. In: Strength and stability of thin-walled aircraft structures (Prochnost' i ustoychivost' tonkostennykh aviatsionnykh konstruktii). Edited by I F Obraztsov. Moscow, Izdatel'stvo Mashinostroenie (Moskovskii Aviatsionnyi Institut, Trudy, No 180), 1971, p. 193-197. In Russian.

Consideration of the problem of constrained torsion of a spar box fastened along isolated parts of the contour. Vlasov's displacement variational method is employed in the calculations. It is shown that the tangential stress distribution does not follow beam theory. The tangential stress distributions along the wing span have maxima which can lead to the failure of the structure.

A B K.

A71-35334 * A small, radio-controlled aircraft as a platform for meteorological sensors. T G Konrad, M L Hill, J R Rowland, and J H Meyer (Johns Hopkins University, Silver Spring, Md.) *APL Technical Digest*, vol 10, Nov-Dec 1970, p 11-19 9 refs. USAF-NASA-supported research.

Description of the development and performance capability of a small radio-controlled aircraft as a versatile measurement platform along with the required radio control and meteorological sensing instrumentation. Experience with the system in several extended field tests has shown that controlled soundings to 4000 ft are possible with the unaided eye. For flights above this altitude, simple optical aids have been developed and soundings to 10,000 ft have been made.

F R L.

A71-35336 # Closed-die forgings for the aircraft industry. II. J A Carver. *Special Steels Review*, Spring 1971, p 6-14.

Carbon and low-alloy steels are forged at temperatures up to 1250 C. Forgings in vacuum remelted steels have greatly improved transverse ductility and microcleanness as compared with those from air-melted stock. Problems with maraging steels and precipitation hardening stainless steels are discussed, giving attention to the dependence of metallurgical qualities of forgings on forging practice. Nickel alloys and superalloys are considered. The forging of titanium alloys is described, taking into account beta alloys, alpha alloys, and alpha-beta alloys. The forgeability and mechanical properties of

titanium alloys are not influenced to any marked degree by variations in the metallic alloying elements, but they are affected by variations in interstitial elements such as oxygen, nitrogen and carbon.

G R

A71-35371 # Influence on land and airspace demands of control techniques in current use. P G Reich (Ministry of Defence, London, England). *Institute of Navigation, Journal*, vol 24, July 1971, p. 355-370 12 refs.

Discussion of the limitations of techniques already commonly applied, and of the more promising points of application for new technology in navigation surveillance and traffic control. Some of the current trends in other fields, particularly aircraft design, are considered. Emphasis is placed on the efficient use of land at airports, in view of the strength of feelings aroused in the community by the questions of apportionment and exploitation of land resources. It is pointed out that, as compared with techniques of navigation surveillance and traffic control, changes in basic aircraft characteristics are potentially a much more powerful means of increasing land productivity and ameliorating problems of noise and vortices.

M M

A71-35372 # Air traffic control and the needs of the customer. E J Dickie (Department of Trade and Industry, London, England). *Institute of Navigation, Journal*, vol 24, July 1971, p 371-378 5 refs.

Discussion of criteria and problems incident on the provision of ATC from the standpoint of the user. Particular requirements presented by the pupil pilot, ultra-light aircraft, gliders, clubs and small private aircraft, business aircraft and air taxi, military aircraft, the test pilot, and airline pilots, are considered. It is pointed out that a possible weakness in present ATC methods is that the controller may have to off-load some of his responsibilities onto the pilot. Perhaps in the distant future the high density ATC system will not only allocate aircraft headings, heights and speeds, but also continuously monitor lateral, vertical and longitudinal operation. Pilots would not then be obliged to maintain track, flight level and airspeed with great precision all the time, but only when it really was necessary to do so in the interests of safety.

M M

A71-35373 # Area navigation. W P Robinson (British Overseas Airways Corp., London Airport, Hounslow, Middx., England). *Institute of Navigation, Journal*, vol 24, July 1971, p 379-383, Discussion, p 383-391.

Examination of means for improving the present ATC system by the use of area navigation. The following typical benefits are provided by area navigation: (1) dual or multitracks for omnidirectional traffic flow, (2) improved economical alignment of routes, (3) dual or multitracks to allow segregation of traffic according to speed or flight configuration, (4) tracks bypassing congested areas, (5) optimum location and size of holding patterns, and (6) procedures designed for STOL and helicopter operation. Potential suppliers are offering area navigation computer equipments of varying sophistication and ranging in price from about \$2500 to over \$150,000. It is concluded that there is a high degree of unanimity between pilots and controllers for early implementation of an area navigation system.

M M

A71-35374 # Development in airborne navigation systems. W O Broughton and J W McIvor (Ministry of Aviation Supply, London, England). *Institute of Navigation, Journal*, vol 24, July 1971, p 392-408, Discussion, p 408-412.

Brief survey of military and civil aircraft navigation, with emphasis on self-contained systems, and a brief reference to external

aids The evolution of self-contained systems since World War II is briefly traced, and an attempt is made to forecast the way development appears likely to go in the future. It is pointed out that there appears to be no need for increased accuracy over that attainable now although, of course, some improvement can be expected from continuing development of systems during production. M M

A71-35387 How the courts look at wake turbulence

Richard H. Jones (Eastern Air Lines, Inc., New York, N.Y.) (*Federal Aviation Administration, Turbulence Symposium, Washington, D.C., Mar. 1971.*) *Journal of Air Traffic Control*, vol. 14, July 1971, p. 26-29.

Review of the history of lawsuits arising from accidents related to wake turbulence, with assessment of the state of the law today. The issue in such litigation is whether the accident was the fault of the pilot of the crashed plane or the fault of the air traffic controller in not maintaining sufficient separation between the two aircraft. In general, recent cases seem to set a trend extending and broadening the government's liability where the controller's act is judged to be negligent. F R L

A71-35398 External heat addition for supersonic propulsion. E. G. Broadbent (Royal Aircraft Establishment, Farnborough, Hants., England) *Ingenieur-Archiv*, vol. 40, no. 3, 1971, p. 168-187. 14 refs

Certain shapes of high speed aircraft, such as caret wings, make use of two-dimensional flowfields and in principle they can be propelled by purely external heat addition without any ducted flow. Suitable undersurfaces can be designed by an exact numerical method. Various examples of the method are given, and comparisons are made of propulsive efficiency, temperature distribution and other variables. (Author)

A71-35403 # Radio control (Radioupravlenie). L. S. Gutkin, V. B. Pestriakov, and V. N. Tipugin (Moscow, Izdatel'stvo Sovetskoe Radio (Sovremennaya Radioelektronika, No. 5), 1970. 324 p. 78 refs. In Russian)

Description of the principles and methods of radio remote control of various flight vehicles (missiles, spacecraft, and aircraft). Modern methods of analyzing and synthesizing closed control loops and compensating systems are explained, together with important requirements posed for radio equipment. Kinematic methods of missile guidance, self-guidance systems, radio-controlled spacecraft trajectory correction systems, methods of measuring parameters of motion, and aircraft radio-navigation and traffic-control systems are described. Command links, analog and digital telemetry and command systems, and feedback links are examined in terms of noise stability, data processing operations, and principal applications. T M

A71-35422 # Calculation of the binary laminar boundary layer in the hypersonic stagnation point flow with temperature-dependent material parameters (Berechnung der laminaren Zweistoff-Grenzschicht in der hypersonischen Staupunktströmung mit temperaturabhängigen Stoffbeiwerten) J. Steinheuer (Braunschweig, Technische Universität, Braunschweig, West Germany) *Zeitschrift für angewandte Mathematik und Mechanik*, vol. 51, Mar. 1971, p. 209-223. 18 refs. In German. Research supported by the Deutsche Forschungsgemeinschaft

An exact and an approximate method are presented for the calculation of a laminar binary-mixture boundary layer for the plane of axisymmetric stagnation point flow at hypersonic velocity with

foreign gas injection. In the exact method the property parameters of the binary gas mixture, i.e., viscosity, thermal conductivity and binary diffusion coefficient as well as density and specific heat capacity must be known as functions of temperature and foreign gas concentration. The approximate method utilizes only the wall-values of these property parameters in conjunction with their mean gradients over the boundary layer thickness. The boundary layer equations form a system of three coupled ordinary differential equations for the stream function, the concentration, and the enthalpy. In the exact method these equations are transformed into a system of integral equations which is solved by an iterative procedure. In the approximate method the boundary layer equations are reduced to their incompressible form. In addition, the asymptotic limit of strong injection is investigated. Numerical examples of calculation for the different methods are presented. (Author)

A71-35439 # Afterburners of modern jet engines (Dopalacze współczesnych silników odrzutowych). Stefan Szczeciński and Ryszard Wiatrek *Technika Lotnicza i Astronautyczna*, vol. 26, June 1971, p. 8-11. In Polish.

Description of typical performance characteristics of jet engines equipped with an afterburner as a means of temporary thrust enhancement, and survey of the structural characteristics of some currently used afterburner designs. Problems of combustion, flame stabilization, and outlet-nozzle regulation are considered, together with operational cost aspects. T M

A71-35442 # Wind and aircraft equipment (Wiatr a sprzęt lotniczy). Józef Osos *Technika Lotnicza i Astronautyczna*, vol. 26, June 1971, p. 31-33. In Polish.

Case histories of damage sustained by aircraft due to wind acting on airport surfaces. The frequency of occurrence and directional statistics of high-velocity winds at Warsaw's Okęcie airport are analyzed, and recommendations are given for wind and hail protection during landing, parking, and maintenance operations. T M

A71-35452 The problem of equivalent testing of gas turbines. N. D. Kuznetsov and V. I. Tsetlin (*Problemy Prochnosti*, vol. 2, Oct. 1970, p. 14-19) *Strength of Materials*, Oct. 1970, p. 980-985. Translation.

Analysis of factors affecting the service life of gas-turbine engine components, on the basis of modern concepts concerning the summation of material defects under the action of physical and thermal static and variable loads. Formulas for evaluating the equivalent service life of materials and components are proposed. V P.

A71-35453 Statistical estimation of the heat-resistant characteristics of materials for gas-turbine motors. II - Dispersion of the long-term strength and creep characteristics as a function of the temperature and duration of the tests. I. P. Bulygin, N. I. Parfenova, L. N. Timofeeva, and I. I. Trunin (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Aviatsionnykh Materialov, Moscow, USSR). (*Problemy Prochnosti*, vol. 2, Oct. 1970, p. 20-24) *Strength of Materials*, Oct. 1970, p. 986-990. Translation.

Discussion of fatigue and creep tests performed with two nickel-base turbine-engine alloys (EP109VD and EI961) at operational temperatures and durations from 100 to 10,000 hr. The laws governing the changes in the dispersion of heat-resistance characteristic are determined as a function of the temperature and service life. The laws obtained make it possible to increase the reliability of strength and performance estimates for turbine-engine materials. V P.

A71-35455 **Computing method of estimating the strength of the jet vanes of gas turbine installations under pulsed thermal conditions.** L. B. Getsov, Iu D. Martynov, Iu S. Oshero, V. A. Plekhanov, E. P. Rivlin, and A. D. Trukhnii (*Problemy Prochnosti*, vol. 2, Oct. 1970, p. 34-37.) *Strength of Materials*, Oct. 1970, p. 1000-1003. Translation

Development of a method of evaluating the service life of solid and hollow turbine guide vanes, which is based on calculating the heat transfer coefficients and the temperature and stress fields, and evaluating the heat resistance of the vanes. The possibility of increasing the service life of uncooled vanes by optimal selection of the cavity geometry is demonstrated. V P

A71-35456 **Statistical analysis of the fatigue characteristics of light alloys in order to facilitate a probability estimation of the strength of aircraft construction parts.** M. N. Stepnov, E. V. Giatintov, and A. S. Seregin. (*Problemy Prochnosti*, vol. 2, Oct. 1970, p. 38-42.) *Strength of Materials*, Oct. 1970, p. 1004-1008. Translation.

Analysis of the fatigue characteristics (obtained in laboratory tests) of aircraft alloys and of their applicability to the evaluation of component endurance. It is shown that for samples of various dimensions and stress concentrations, there exists a common fatigue curve in relative coordinates. Using this curve, the fatigue characteristics of structural elements can be determined on the basis of test data. V P

A71-35460 **Equivalent testing of gas-turbine engines.** N. D. Kuznetsov (*Problemy Prochnosti*, vol. 2, Oct. 1970, p. 74-77.) *Strength of Materials*, Oct. 1970, p. 1042-1045. Translation

Discussion of possibilities of shortening the test time required to increase the service life of aircraft engines. It is proposed to conduct an equivalent test along a program constructed on the basis of an analysis of factors which influence the service life of the individual units and components of an engine. Factors which affect the service life of engine components and lend themselves to quantitative evaluation include failure by fatigue, creep, stress relaxation, heat resistance, wear, and contact endurance. Special tests (not included in equivalent testing) should be conducted to determine the influence on service life of such factors as fuel and lubricant coking, erosion and contamination of components, and random accidental damage (such as of blade edges). V P

A71-35467 # **Coherence criteria for supersonic compressor tests (Critères de cohérence pour essais de compresseurs supersoniques).** Christian Capillon and Jean Reboux (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) *La Recherche Aéronautique*, May-June 1971, p. 139-149. In French

Establishment of coherence criteria for measurements used in judging the effectiveness of tests carried out. This is necessary in order to determine various aerodynamic and thermodynamic magnitudes essential for the detailed understanding of complex processes arising in a compressor where the flow passes several times from the supersonic to the subsonic region. These criteria have been defined and perfected on an experimental freon compressor with low blade height and a cylindrical test section, accurately representing a mobile supersonic annular cascade. It appears that elementary compression processes can be achieved with such a compressor, which is also suitable for flow visualization, and is also an excellent model for investigation of a cylindrical section of a long blade supersonic compressor. F R L

A71-35468 # **Linearized theory of the unsteady subsonic flow in a two-dimensional straight cascade (Théorie linéarisée de l'écoulement subsonique instationnaire dans une grille droite bidimensionnelle).** Jacques Leclerc (ONERA, Châtillon-sous-Bagneux,

Hauts-de-Seine, France) *La Recherche Aéronautique*, May-June 1971, p. 151-163. 11 refs. In French

Consideration of the general problem of the blade stability of a mobile wheel, assuming a light dispersion of the mechanical characteristics of the blade, taking rotor inertia into account in the overall rotational vibration. The problem of unsteady local lift calculation is treated for two configurations, considering the wheel as an infinite two-dimensional cascade with any pitch and angular setting. In the first case the blade vibration is assumed to be harmonic, synchronous, and identical except for its phase from one blade to the next. In the second case all blades but one are assumed to be fixed. Poisson's method is used. The series directly defining the pressure kernel is replaced by a simpler and much more rapidly converging series obtained by a Poisson transform. The effects of blade profile camber and of steady angle of attack, when these are moderate, are taken into consideration by introducing a supplementary term which depends linearly on the steady circulation. F R L

A71-35470 # **Calculation of aircraft, helicopter blade, or turbine blade airfoils for the exact compressibility law (Calcul de profils d'ailes d'avions, de pales d'hélicoptères ou d'aubes de turbomachines pour la loi de compressibilité exacte).** Robert Legendre (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) *La Recherche Aéronautique*, May-June 1971, p. 167, 168. In French

Development of a method simpler than that of Cauchy-Fredholm for solving the Dirichlet problem in the plane of the hodograph of the plane flow of a compressible fluid. The method has the advantage of directly furnishing the potential, ψ , of the flow, and generalizes the method which is applicable to harmonic functions. F R L

A71-35488 # **The development of a three-micron absolute main oil filter for the T53 gas turbine.** C. W. Lynch (Avco Corp., Avco Lycoming Div., Stratford, Conn.) and R. B. Cooper (*American Society of Mechanical Engineers, Fluids Engineering, Heat Transfer, and Lubrication Conference, Detroit, Mich., May 24-27, 1970.*) *ASME, Transactions, Series F - Journal of Lubrication Technology*, vol. 93, July 1971, p. 430-436

Description of the assembly design, indicator system, bench testing, and 6000-hr engine testing of the three-micron absolute main oil filter developed for the T53 gas turbine. The new disposable elements, running approximately 300 hours without clogging, provide a much cleaner lubrication system and have eliminated requirements for 25 hour filter inspections and 100 hour oil drains. One of the benefits of the new filter consists in that wear caused by the abrasive action of oil containing one to five micron particles is prevented through removal of these particles. The other benefit is the marked absence of oil degradation with clean oil over long drain intervals. M V E

A71-35526 # **Concorde and C.E.V.: Cooperation between firms and government offices or establishment in the flight test program - Certification flights.** J. Renaudie (Centre d'Essais en Vol, Brétigny-sur-Orge, Essonne, France) *American Institute of Aeronautics and Astronautics, Aircraft Design and Operations Meeting, 3rd, Seattle, Wash., July 12-14, 1971, Paper 71-784*. 14 p. Members, \$1.50, nonmembers, \$2.00

The flights which mark the progress made with the Concorde are examined, and aspects of the training of the official pilots are considered. The structure of the French organization for aircraft development certification and the Concorde flight test organization are shown. The functions of the CEV are discussed giving particular attention to their work in connection with the Concorde. A table is presented showing Concorde flying hours up to certification. G R

A71-35527 # Acoustics program for the Grumman Gulfstream II. Russell P. Goss (Grumman Aerospace Corp., Bethpage, N.Y.) *American Institute of Aeronautics and Astronautics, Aircraft Design and Operations Meeting, 3rd, Seattle, Wash., July 12-14, 1971, Paper 71-783.* 11 p. Members, \$1.50, nonmembers, \$2.00.

The goals of the Gulfstream II acoustics program were low noise levels in the cabin, compliance with Port of New York Authority (PONYA) airport noise criteria, FAA takeoff and landing noise certification, and qualification of structure against sonic fatigue. Noise levels as low or lower than those in airline and business aircraft were obtained using an improved sidewall treatment, four-pane cabin windows, airconditioning silencers and isolation mountings for major vibration sources such as the engines, APU, and inverter. PONYA criteria were met and FAA noise certification obtained using thrust cutback during take-off, the airplane has enough thrust to maintain a favorable climb rate even with the required thrust cutback. Structures exposed to high noise levels during normal and reverse thrust operations were tested to assure lifetime resistance to sonic fatigue. (Author)

A71-35528 # 4-D guidance of STOL aircraft. Robert J. Hynes, Lloyd E. Stevenson, and E. B. Capen (U.S. Department of Transportation, Transportation Systems Center, Cambridge, Mass.) *American Institute of Aeronautics and Astronautics, Aircraft Design and Operations Meeting, 3rd, Seattle, Wash., July 12-14, 1971, Paper 71-770.* 44 p. 7 refs. Members, \$1.50, nonmembers, \$2.00.

Prior to the advent of large-scale commercial STOL service, some challenging navigation and guidance problems must be solved. Proposed terminal area operations may require that these aircraft be capable of accurately flying complex flight paths, and in some situations, maintaining a time of arrival envelope at way-points along these paths (4-D guidance capability). This paper discusses problems that arise in performing 4-D guidance and presents the results of an initial investigation of two of the candidate 4-D guidance schemes that have been suggested. The investigation was primarily concerned with evaluating basic concepts and assumed a single aircraft environment and the availability of perfect information to both the pilot and the controller. Other techniques are being investigated by the FAA that may hold more promise when actual operational constraints are imposed on the problem. Preliminary simulation results are presented and future work on the 4-D guidance of STOLs is outlined. The results although presented for STOLs are applicable also to the 4-D guidance of any RNAV equipped aircraft. (Author)

A71-35529 # The total in-flight simulator (TIFS) - A new aircraft design tool. Philip A. Reynolds (Cornell Aeronautical Laboratory, Inc., Buffalo, N.Y.) and James R. Pruner (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics, Aircraft Design and Operations Meeting, 3rd, Seattle, Wash., July 12-14, 1971, Paper 71-794.* 12 p. 9 refs. Members, \$1.50, nonmembers, \$2.00. Contracts No. AF 33(615)-67-C-1157, No. AF 33(615)-71-C-1110.

TIFS is a newly developed, variable stability C-131 aircraft with the unique capability to vary its flying qualities in all six degrees of freedom. It also surpasses the utility of past variable stability aircraft through the realism possible in its separate, new evaluation cockpit. The capabilities and features of this in-flight simulator considerably broaden the ability of the designer to deal with difficult tradeoffs in flying qualities problems. This paper describes the aircraft and its potential as a design tool. Physical characteristics as determined in flight and examples of simulation planning are given. Flight test records of model-following performance are included. (Author)

A71-35530 # The design and test of an integrally armored cockpit. James Hodges (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) and A. H. Pedersen (McDonnell Aircraft Co.,

St. Louis, Mo.). *American Institute of Aeronautics and Astronautics, Aircraft Design and Operations Meeting, 3rd, Seattle, Wash., July 12-14, 1971, Paper 71-778.* 13 p. Members, \$1.50, nonmembers, \$2.00.

Cockpit armor improves combat effectiveness for given mission objectives. The tradeoff is not armor weight vs aircraft performance, but combat effectiveness vs attrition. A cockpit concept exploiting integral armor as the structural system is developed, and terminal ballistic kinematics for a rapidly moving aircraft target are examined experimentally. A significant weight saving is shown to result from exploiting the relevant kinematics, mold line tumbling plates, and integral structural armor. An armor design criteria is developed and demonstrated in full-scale experiments under threats representative of close air support operations. Mission tailored integral armor is shown to enhance combat effectiveness. (Author)

A71-35531 # L-1011 flight test program. J. F. Woodman (Lockheed-California Co., Burbank, Calif.) *American Institute of Aeronautics and Astronautics, Aircraft Design and Operations Meeting, 3rd, Seattle, Wash., July 12-14, 1971, Paper 71-789.* 17 p. Members, \$1.50, nonmembers, \$2.00.

Description of the features and results of the testing of the L-1011 TriStar three-engined commercial jetliner. It is pointed out that the TriStar has successfully cleared its most critical flight test points on schedule with no indication whatever of a major structural or design problem. Although much of the statistical analysis of systems and equipment is yet to be obtained, it can be confirmed that original design goals have been met and that the aircraft will provide the advanced economic and operational capabilities required by airlines during the next two decades. Perfect or near perfect performances have been registered by the TriStar's Autoland and AFCS (Avionic Flight Control System) systems, the flight controls, hydraulics, brakes and APU (Auxiliary Power Unit). M M

A71-35532 # Laboratory development of selected systems in the Lockheed L-1011 TriStar. G. Sim and C. M. Onspaugh (Lockheed-California Co., Burbank, Calif.) *American Institute of Aeronautics and Astronautics, Aircraft Design and Operations Meeting, 3rd, Seattle, Wash., July 12-14, 1971, Paper 71-782.* 18 p. Members, \$1.50, nonmembers, \$2.00.

Through the medium of the L-1011 laboratory test program, selected design features of the airplane are reviewed. The all-flying stabilizer, the direct lift control and the autoland systems are examined in the context of the design background and the developmental test programs employed. The early flight performance in automatic landing is illustrated to demonstrate the merits of comprehensive ground testing in complex system development. (Author)

A71-35533 # Integral variable geometry fuel tankage. Levelle Mahood (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) *American Institute of Aeronautics and Astronautics, Aircraft Design and Operations Meeting, 3rd, Seattle, Wash., July 12-14, 1971, Paper 71-763.* 20 p. Members, \$1.50, nonmembers, \$2.00.

Discussion of a test program for variable-geometry external fuel tank prototypes to evaluate their performance as components of operational aircraft by static structural tests, wind tunnel tests, and flight tests on a F-111 aircraft. The elimination of the need for different capacity tanks for one aircraft and a greater range for more fuel are noted as the advantages of the variable geometry tank designs over present drop fuel tanks. Details are given on an integral variable geometry fuel tank concept that will use the existing aircraft structure, thus minimizing the requirement for unique components. Also considered is a strike fighter concept with an integral variable geometry tank mounted at the intersection of the fuselage and top of the high wing. The attractiveness and the formidable technical challenges of the development of integral variable geometry fuel tankage are indicated.

A71-35582 Utilization and development prospects of satellites for the civil aviation and merchant marine (Perspectives d'utilisation et de développement des satellites pour l'aviation civile et la marine marchande) Bertrand Manuali (Centre National d'Etudes Spatiales, Paris, France) *Navigation* (Paris), vol 19, July 1971, p. 299-315 5 refs In French

The nature and magnitude are assessed of aircraft and seacraft location and communication needs of civil aviation and merchant marine management that a satellite system could meet effectively, and a preliminary definition is attempted of the essential characteristics that such a satellite system should possess. An evaluation of the global number of high-grade communication channels the civil aviation and merchant marine is likely to need is followed by a review of the implications of aircraft and seacraft antenna characteristics and of present modulation techniques for optimum communication channel frequencies between satellites and seacraft and aircraft, as well as between satellites and ground stations. The operational utilization prospects of an Atlantic-Pacific three-satellite system is then discussed, along with the technical and economic potentialities of a first satellite generation. M V E

A71-35604 # Study of the stability of a gyrohorizon-compass (K issledovaniyu ustoychivosti girogorizontkompasa). S P Sosnitskii *Akademiya Nauk SSSR, Izvestiya, Mekhanika Tverdogo Tela*, May-June 1971, p. 26-28 5 refs In Russian

The stability of a gyrocompass is analyzed, taking into account the vertical inertia component of its translational motion. This component is shown to exert an appreciable effect on the oscillations of the sensitive element of the system. Relations are obtained to calculate the stability characteristics of a gyrocompass during circulations and arbitrary periodic maneuvers of the ship. V Z

A71-35608 # The problem of errors of a gyro device mounted on a mobile platform (K voprosu o pogreshnostiakh giroskopicheskogo pribora, ustanovlennogo na podvizhnoi platforme) V F Kulakov and Iu V Osetinskii *Akademiya Nauk SSSR, Izvestiya, Mekhanika Tverdogo Tela*, May-June 1971, p. 61, 62 In Russian.

The effect of rotor asymmetry on the performance of a two-degree-of-freedom gyro device mounted on a dynamic platform is discussed. It is shown that an insignificant rotor asymmetry with respect to the rotation axis can cause appreciable errors in the measurements of angular velocities and rotation angles. V Z

A71-35625 * # Propulsion systems trends. James F. Dugan, Jr (NASA, Lewis Research Center, Advanced Systems Div., Cleveland, Ohio) *University of Tennessee Space Institute, Systems Oriented Workshop on U.S. Transportation, Tullahoma, Tenn., June 20-July 17, 1971, Paper. 33* p. 7 refs

Propulsion systems as they exist today and some trends that are anticipated for aircraft that might be flying in the 1980s are presented. The number one trend for commercial engines is to quiet them to a level no louder than the normal background noise level of the environment in which they will operate. In military engines that are not so severely noise constrained, the possibility of stoichiometric gas turbine engines is within reach and will probably come into being whenever a military requirement provides sufficient motivation to develop such an engine. Very high bypass ratio engines are likely to find application in V/STOL aircraft while the evolution of variable geometry inlets and exhaust nozzles receives its impetus from supersonic airplanes. Both supersonic and V/STOL aircraft are prime candidates for digital computer control systems that will integrate the control of the propulsion system, the airplane, and its flight path. Multimode propulsion systems and supersonic combus-

tion ramjets may one day be utilized in hypersonic cruise and boost aircraft while the first nuclear propelled aircraft most likely will fly at subsonic speeds. (Author)

A71-35629 # Flow behind the boundary layer separation point in supersonic flow (Tchenie za tochkoj otryva pogranichnogo sloia v sverkhzvukovom potoke) V Ia Neiland *Akademiya Nauk SSSR, Izvestiya, Mekhanika Zhidkosti i Gaza*, May-June 1971, p. 19-25 8 refs In Russian

Theoretical study of the flow structure behind the separation point of a laminar boundary layer in supersonic flow. Analytical and numerical solutions are obtained for simple semiinfinite separation regions beginning at the leading edge or on a smooth surface. The pressure plateau in a finite-length separation region is calculated on the basis of an asymptotic theory. The behavior of the solution is analyzed in the region of free interaction and during transition into the reversed flow region. The results obtained made it possible to calculate (in the first approximation) the pressure in the plateau region and to formulate a mathematical basis for this effect. Relatively simple solutions are simultaneously obtained for semiinfinite separation regions. T M

A71-35630 # Calculation of the interaction of a supersonic jet with a turbulent near wake behind a step (Raschet vzaimodeistviya sverkhzvukovoi strui s turbulentnym blizhnim sledom za ustupom) L V Gogish and L V El'nikova *Akademiya Nauk SSSR, Izvestiya, Mekhanika Zhidkosti i Gaza*, May-June 1971, p. 26-32 In Russian

Investigation of plane and axisymmetric flow behind the butt face of a body placed in a supersonic jet flow. The interaction of the supersonic jet and the turbulent wake is described by a system of eight first-order differential equations, two of these equations pertain to a single-parameter wake, while the remaining ones describe the flow in a quasi-one-dimensional inviscid jet. Flow in the near wake corresponds to a singular solution of the equations, which passes through a saddle singular point (the neck of the wake). Initial conditions for the interaction flow are determined from integral conditions for the joining of this flow with the mixing flow in the isobaric base region. The calculations are in satisfactory agreement with experimental data obtained by measuring pressures along the wake and at the butt face for a plane Mach-2.3 jet. T M

A71-35631 # Calculation of the interaction of a turbulent boundary layer with a supersonic outer flow behind a step (Raschet vzaimodeistviya turbulentnogo pogranichnogo sloia s vneshnim sverkhzvukovym potokom za ustupom) A N Antonov *Akademiya Nauk SSSR, Izvestiya, Mekhanika Zhidkosti i Gaza*, May-June 1971, p. 33-40 15 refs In Russian

The proposed integral method of calculating the turbulent flow behind plane and axisymmetric bases makes it possible to determine the pressure distribution, the displacement thickness, the momentum thickness, and the friction in the region of interaction between a boundary layer and an ideal outer flow. The characteristics of an incompressible, turbulent, equilibrium boundary layer are used to calculate the flow behind the base, the flow parameters of a compressible boundary layer are related to those for an incompressible layer by the Cowles-Crocco transformation. Results are compared with experimental data. T M

A71-35632 # Three-dimensional boundary layer on a segmented body at supersonic velocities (O prostranstvennom pogranichnom sloe na segmental'nom tele pri sverkhzvukovykh skorostiakh). G N Andreev and Iu D Shevelev *Akademiya Nauk SSSR, Izvestiya, Mekhanika Zhidkosti i Gaza*, May-June 1971, p. 41-48 6 refs In Russian

The finite difference method is used to calculate the three-dimensional boundary layer arising on sphere-segment surfaces placed in supersonic flow. The strong local change in the profile curvature near the edge of the spherical surface of a body formed by the sector of a sphere makes it necessary to separate three different regions of gas flow. These regions include the flow on the spherical surface, flow near the edge of this surface, and flow along the inverted cone behind this surface. A curvilinear difference grid is constructed on the surface of the body. The difference equations approximating the initial system of differential equations are set up for the case of arbitrary nonequidistant nodes of the grid. Numerical results are given for the drag and heat flux to the body at given wall temperatures, unity Prandtl number, linear dependence of viscosity on temperature, and angles of attack between 15 and 30 deg. T M

A71-35633 # Self-similar numerical and asymptotic solutions of boundary layer equations for intense blowing (Ob avtomodel'nykh chislennykh i asimptoticheskikh resheniyakh uravnenii pogranichnogo sloia pri bol'shikh vduvakh). E A Gershbein (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, May-June 1971, p. 49-52. 6 refs. In Russian.

Analysis of self-similar solutions of equations for a laminar, multicomponent, isothermal boundary layer at large rates of injection. Asymptotic velocity profiles and boundary layer thicknesses are given for different negative pressure gradients. Numerical solutions of the boundary layer equations are given for injection of a hydrogen, nitrogen, and carbon dioxide gas mixture from the surface. The asymptotic solution is compared with the numerical results and its range of validity is delineated. T M

A71-35636 # Investigation of the nonequilibrium condensation in supersonic jets and nozzles (Issledovanie neravnovesnoi kondensatsii v sverkhzvukovykh soplakh i struiakh). L M Davydov. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, May-June 1971, p. 66-73. 7 refs. In Russian.

The method of characteristics is used to calculate gas flows with allowance for equilibrium and nonequilibrium condensation processes. The proposed recurrent relationships for calculating condensation kinetics along the streamline substantially simplify the computational scheme and reduce the time required for calculation. The method is used to study the influence of the nonequilibrium of the condensation process on the flow of gas in supersonic nozzles and jets issuing into vacuum. A proposed approximate method for calculating nonequilibrium condensation is based on integration of one-dimensional equations along a streamline, using the flux density distribution along this streamline. T M.

A71-35646 # Contribution to the theory of transonic flows (K teorii dvumernykh okolozvukovykh techenii). N G Bol'man. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, May-June 1971, p. 178, 179. 5 refs. In Russian.

The Navier-Stokes equations describing two-dimensional steady transonic flows of a viscous gas are reduced to a system of quasi-linear equations which in turn lead to a linear equation. The conditions for the uniqueness of solutions to boundary value problems for the linear equation are established for flows past bodies of revolution and for two-dimensional bodies. A variety of boundary conditions for which the uniqueness of the solution can be proved by the method proposed are examined. V P

A71-35647 # Calculation of the supersonic flow past V-shaped wings by the method of establishment (Raschet sverkhzvukovogo obtekaniiia V-obraznykh kryl'ev metodom ustanovleniia). V I Lapygin. *Akademiia Nauk SSSR, Izvestiia, Mekhanika*

Zhidkosti i Gaza, May-June 1971, p. 180-185. 12 refs. In Russian.

A method, in which the stationary solution is obtained as the limit of the nonstationary solution, using a large number of time steps, is applied to the determination of the flow past V-shaped wings with supersonic leading edges. The 'method of establishment' is applied to the space variable with respect to which the system of equations of motion is hyperbolic, making use of Rusanov's (1968) difference scheme. The pressure distribution over the wing span is determined. V P

A71-35649 # T-tail aeroelastic analysis for Fokker F.28. J. Yff and R. J. Zwaan (Fokker-VFW, Amsterdam, Netherlands). *NATO, AGARD, Symposium on Unsteady Aerodynamics for Aeroelastic Analyses of Interfering Surfaces, Tonsberg, Norway, Nov. 3, 4, 1970, Paper 17* p. 8 refs.

Experimental and theoretical aeroelastic analysis of the Fokker F.28 T-tail, using a flutter model and flight flutter tests. Control surface flutter and the effects of lateral gust loading were also investigated. A T-tail aircraft generally involves aeroelastic and dynamic problems due to the fact that the top-mounted stabilizer causes very low fin resonance frequencies, and involves a large mass coupling between fin bending and fin torsion, as well as an aerodynamic coupling due to interference effects. For the F.28 this already unfavorable situation was even more complicated by the low fuselage resonance frequencies as a consequence of the rear-mounted engines. It was found that aerodynamic interference is of prime importance for the calculation of lateral gust design loads and largely influences flutter behavior. F.R.L.

A71-35752 NAECON '71; Institute of Electrical and Electronics Engineers, National Aerospace Electronics Conference, Dayton, Ohio, May 17-19, 1971, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1971. 317 p. Members, \$10.00, nonmembers, \$13.50.

Sessions cover recent developments regarding environmental quality, aircraft wake turbulence, avionic communications, airborne reconnaissance, and navigation. Approaches to vehicle electric systems are discussed together with time frequency concepts for better aerospace utilization, microelectronics, and biocybernetics. Other papers cover new developments in the field of computers giving attention to the development of a higher order language architecture. G R

A71-35753 Aircraft wake turbulence - An expanding area of low-speed aerodynamics research. John H. Olsen (Boeing Scientific Research Laboratories, Seattle, Wash.). In *NAECON '71*, Institute of Electrical and Electronics Engineers, National Aerospace Electronics Conference, Dayton, Ohio, May 17-19, 1971, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 17-22.

A review of recent findings on the structure of a vortex wake and its interactions with following aircraft is given. The review is based on results reported at the September 1970 Aircraft Wake Turbulence Symposium sponsored by the Air Force Office of Scientific Research and the Boeing Scientific Research Laboratories. Formation and disintegration processes are discussed including recently discovered instability mechanisms. Interactions between a wake and a following aircraft are shown to depend primarily on the circulation of the wake and the span of the following aircraft. Various methods suggested for reducing wake hazards are discussed. Finally areas for further research are suggested. (Author)

A71-35754 A trailing vortex model and its effect on a penetrating aircraft. Neal L. Funston (USAF, Aeronautical Systems

Div , Wright-Patterson AFB, Ohio) and Stephen J Koob (USAF, Institute of Technology, Wright-Patterson AFB, Ohio) In NAECON '71, Institute of Electrical and Electronics Engineers, National Aerospace Electronics Conference, Dayton, Ohio, May 17-19, 1971, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc , 1971, p 23-27 5 refs

The high strength of the trailing vortex system produced by the new jumbo jet aircraft has renewed interest in the study of the vortex phenomenon and its effect on proximate aircraft operations. In the present study, the trailing vortex system produced by an aircraft in flight and penetration of the system by a second aircraft are modeled mathematically. The effect of turbulent mixing on the persistence of the intact trailing vortices is modeled by modifying the similar solution for a decaying laminar vortex. The correction is made by introducing an effective turbulent viscosity which is determined empirically. The vortex induced velocity is superimposed on the free stream velocity of a penetrating aircraft to determine a total velocity vector and angle of attack history. Separation times and distances required for safe operation in traffic pattern conditions are predicted using a gust load formula and maximum incremental load factors. Calculations were performed for several generator/penetrator aircraft combinations (Author)

A71-35755 Analysis of experimental measurements of trailing vortex systems of large jet transport aircraft. Joseph J Eisenhuth, Barnes W McCormick, Robert C Nelson (Aero Engineering Associates, State College, Pa), and Leo J Garodz (FAA, Atlantic City, N.J.) In NAECON '71, Institute of Electrical and Electronics Engineers, National Aerospace Electronics Conference, Dayton, Ohio, May 17-19, 1971, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc , 1971, p 28-35

This paper presents an analysis of data obtained by the Federal Aviation Administration related to the characteristics of trailing vortex systems generated by large jet aircraft. Difficulty was experienced in analyzing the data because of the comparatively large spacing of sensors, but some significant information and conclusions can be derived from the analysis. It was found that the velocity field around a vortex produced by a large jet aircraft is defined by a logarithmic variation of circulation with radius. For a lift coefficient of unity, the core diameter was found to be approximately 5% of the midspan chord while the maximum tangential velocity at the edge of the core was about 70% of the aircraft velocity. Both the diameter and core appear to change in proportion to the lift coefficient. Expressions are developed for predicting the velocity field produced by the trailing vortices from large aircraft. These should be used with caution, however, until additional and more precise data are obtained (Author)

A71-35756 Development of a vortex laser Doppler velocimeter. David G Francis (ARO, Inc., Arnold Engineering Development Center, Arnold Air Force Station, Tenn.) In NAECON '71, Institute of Electrical and Electronics Engineers, National Aerospace Electronics Conference, Dayton, Ohio, May 17-19, 1971, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc , 1971, p 36-40 6 refs

Preliminary report on the status of a development project for a three-component laser Doppler velocimeter system capable of mapping velocity profiles or aircraft wake turbulence at altitudes up to 1000 ft. Optical arrangements and tests results for back-scattering and forward-scattering dual scatter systems are described, together with equipment details of a prototype velocimeter intended for measurements at 200 ft in the first phase of the development program T M

A71-35757 The vortex wake hazard of large transports in take-off and landing. Nicholas R Rotta and Theodore R Goodman

(Oceanics, Inc., Plainview, N.Y.) In NAECON '71, Institute of Electrical and Electronics Engineers, National Aerospace Electronics Conference, Dayton, Ohio, May 17-19, 1971, Proceedings.

New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p 41-46 14 refs Contract No. AF 44(620)-70-C-0106

The configuration stability of a vortex pair in ground effect is examined for the trailing vortex wake of a large high weight aircraft. In ground effect, the large scale motion of the vortices is adequately represented by the equations of potential theory which shows the vortex pair to descend to lower altitudes with increased separation. The stability theory indicates the vortex pair to be unstable, with the instability and time estimated for break-up shown to depend on the altitude at which the vortex pair was generated. The results of the study of the landing of a 747 shows good agreement with FAA full-scale flight tests for the behavior of the vortex wake at low altitudes (Author)

A71-35758 The AN/ARC-154(V) - A new approach to airborne communications. Bernard J Beitman, Jr (Avco Corp., Avco Electronics Div., Cincinnati, Ohio) In NAECON '71, Institute of Electrical and Electronics Engineers, National Aerospace Electronics Conference, Dayton, Ohio, May 17-19, 1971, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p 47-51

The AN/ARC-154(V) (Avco AT-430) provides, in a single radio, capabilities normally implemented with two separate transceivers. Covering the 2 to 76 MHz frequency range with USB, LSB, AME and FM modes, the ARC-154 provides more capability than separate hf/SSB and vhf/FM equipments and is expected to find wide application in the smaller and single seat aircraft. Flight tests conducted by ASD/WPAFB have demonstrated the practicality of the radio. Since the ARC-154 presents a new approach to airborne communications, a brief technical discussion is presented at the block diagram level, emphasizing new concepts. Using the ARC-154 as the foundation, the concept of extended frequency coverage and multimode operation is expanded. Consideration is given to adding uhf/AM (225 to 400 MHz) and vhf/AM (110 to 156 MHz). Having discussed the possibility of providing a total communications capability, navigation is discussed. Input/output provisions and their possible inclusion in the radio are reviewed for marker beacon, omni, ILS, and uhf/ADF (Author)

A71-35767 The application of Omega navigation to general aviation. Richard H McFarland (Ohio University, Athens, Ohio) In NAECON '71, Institute of Electrical and Electronics Engineers, National Aerospace Electronics Conference, Dayton, Ohio, May 17-19, 1971, Proceedings New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p 107-112 6 refs

Omega navigation being implemented by the US Navy has application to general aviation operations. Flight experiments with a Beechcraft Bonanza have shown some of the capabilities provided by this system. These experiments also showed some of the deficiencies, all of which are believed surmountable with application of some creative engineering. A proposed solution for overcoming one deficiency, diurnal course shift, is presented in this paper together with experimental data indicating that the approach is a viable one. Pros and cons of Omega as applied to general aviation aircraft navigation are also presented (Author)

A71-35770 Application of power conditioning to high-voltage dc electric power systems for flight vehicles. Frank L Raposa (U.S. Department of Transportation, Transportation Systems Center, Cambridge, Mass.) In NAECON '71, Institute of Electrical and Electronics Engineers, National Aerospace Electronics Conference,

Dayton, Ohio, May 17-19, 1971, Proceedings
New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p 129-136 6 refs

This paper discusses the functions of power conditioning for application to a high-voltage dc electric power system. Sample load profiles of an SST-type aircraft are presented, and the power conditioning needs are outlined. Present and projected power levels of power conditioners for different high-voltage dc distribution systems are discussed. The characteristics of thyristor switches are reviewed, and the technology status of thyristor power conditioners is discussed. Two classes of thyristor power amplifiers are identified for application to the flight vehicle. (Author)

A71-35771 An assessment of high-voltage dc electrical power in aircraft electrical systems. B J Wilson and J P O'Connor (U.S. Navy, Naval Research Laboratory, Washington, DC) In NAECON '71; Institute of Electrical and Electronics Engineers, National Aerospace Electronics Conference, Dayton, Ohio, May 17-19, 1971, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p 143-149 5 refs

If the presently used three-phase ac transmission system on aircraft were replaced by a higher voltage dc system using a ground return, significant gains could be achieved in the weight of wiring, number of wires, and total losses. A comparison of weight advantages and anticipated disadvantages with a 345-V dc system leads to the recommendation of 230 V as a standard value for a dc system. A qualitative comparison is made between projected 230-V dc generation equipment and the presently available constant-frequency three-phase ac equipment. Little weight savings or efficiency gains are anticipated, but the simplicity of the dc system would lessen present problems in paralleling and maintenance. A comparison of utilization equipment for the two generation systems also shows little reduction in weight. Appreciable development work is anticipated before realizing utilization equipment to operate at the higher dc voltage. Although considerable weight reduction in the weight of transmission system wiring is possible, the adoption of the high voltage dc system will not be readily accepted until proven generating and utilization equipment is available. T M

A71-35772 Real-time display system for increased reconnaissance effectiveness. Gerald Glatt and Alfred Paley (Loral Electronics Corp., Bronx, NY) In NAECON '71, Institute of Electrical and Electronics Engineers, National Aerospace Electronics Conference, Dayton, Ohio, May 17-19, 1971, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p 150-157

A conceptual real-time reconnaissance cockpit display system (RTRCDS) for airborne sensor systems is presented whose elements provide night combat sensor imagery in the cockpit of reconnaissance aircraft and on the ground at command posts. Loral studies of techniques using dark trace storage tubes for the real-time high resolution display of line scan sensor data and MTF analysis of performance are described. Uses of the real-time display as a navigation aid, for Bomb Damage Assessment and for target detection, as well as display modes to meet human factor requirements for operator efficiency are discussed. Flight test results are assessed for reconnaissance effectiveness and are extrapolated for future improvement. (Author)

A71-35775 A universal function unit for avionic and missile systems. Frank J Langley (Raytheon Co., Missile Systems Div., Bedford, Mass) In NAECON '71, Institute of Electrical and Electronics Engineers, National Aerospace Electronics Conference, Dayton, Ohio, May 17-19, 1971, Proceedings.

New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p 178-185 14 refs

The development of digital computer technology over the past 25 years has resulted in a degree of maturity in design and functional circuits which enabled a universal, low-cost processor to be defined for mass production and use in virtually all computing and data handling applications, thereby eliminating costly special purpose designs and complex computer architecture. This paper describes the universal function unit, using design concepts already proven in an existing experimental unit, and reviews current and future avionic and missile digital processing requirements, illustrating the application of the universal processor and the realization of the processing load together with other major operational requirements. (Author)

A71-35778 A hardware executive control for the advanced avionic digital computer system. R. O Berg and K J Thurber (Honeywell, Inc., Minneapolis, Minn) In NAECON '71, Institute of Electrical and Electronics Engineers, National Aerospace Electronics Conference, Dayton, Ohio, May 17-19, 1971, Proceedings.

New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p 206-213. 6 refs. Contract No N 62269-70-C-0314.

Executive control of an advanced multicomputer system requires a considerable amount of high speed computations. A special purpose hardware unit designed specifically to accomplish these computations can enhance system operation. Such a hardware unit, utilizing an associative memory, is defined. A definition of the AADC base-line system is presented along with the functional requirements of the executive. The operational philosophy and justification for the consideration of a special purpose hardware executive is given. A functional description of the proposed executive is shown with a list of all required functions. One function is described in detail. The complexity required and the estimated computational speeds obtainable, with the proposed hardware executive, are presented and compared to equivalent software executives. Significant increases in speed with no penalty in cost or reliability can be realized through the utilization of a special purpose hardware executive control containing an associative memory.

(Author)

A71-35780 The 'best' aircraft electric power system ever invented. John H Chaffin (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex) In NAECON '71, Institute of Electrical and Electronics Engineers, National Aerospace Electronics Conference, Dayton, Ohio, May 17-19, 1971, Proceedings.

New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p 218-224

'Best' power system design effectively combines reliability, simplicity, low cost, weight and size. The F-111 system meets this criteria. Complete redundancy is provided in the primary ac power and in the 28 volt dc power systems. Conventional brushless, oil-cooled, 60 KVA generators supply two load buses which normally are isolated but can be connected together in event of generator failure. DC power is provided from paralleled load buses supplied by two 150 ampere converters. The buses can be isolated in emergencies. Emergency power is supplied by a 10 KVA constant speed generator. The primary generators are synchronized to eliminate beat frequencies. Solid state control and protection circuits provides automatic protection against out of tolerance voltage and frequency. The pilot is provided manual control of generator contactors. System status is presented by warning lights and a bus condition indicator. The system has proven to be reliable, easily maintained, and has probably a lower weight to power available ratio of any aircraft power system to date. (Author)

A71-35781 Integrated drive generator offers significant advantages for aircraft electrical power systems. J K Taulbee

(Westinghouse Electric Corp., Aerospace Electrical Div., Lima, Ohio). In NAECON '71, Institute of Electrical and Electronics Engineers, National Aerospace Electronics Conference, Dayton, Ohio, May 17-19, 1971, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 225-228.

The new line of aircraft generators described offers dramatic improvements in weight and reliability. The weight is less than half, and the life has increased by a factor of 10 when compared to the best equipment formerly available. These advantages are primarily the result of a new cooling method. The generators are cooled by oil sprayed directly on the heat generating components. (Author)

A71-35782 Power controllers for automatically controlled electrical systems. D. E. Baker (Westinghouse Electric Corp., Aerospace Electrical Div., Lima, Ohio). In NAECON '71, Institute of Electrical and Electronics Engineers, National Aerospace Electronics Conference, Dayton, Ohio, May 17-19, 1971, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 229-233.

The Remote Power Controller (RPC) is the static counterpart of the electromechanical protective circuit breaker. RPCs are essential to the realization of a truly static Automatically Controlled Electrical System for aircraft and spacecraft applications. The RPC provides the load control needed to execute the commands of the distribution computer as well as the protection needed to protect the system wiring and the RPC itself against overloads and faults. Therefore, the development of the RPC is of substantial importance. The RPC performance requirements place large demands on the power semiconductor devices and circuit configurations. These demands are advancing the state of the art in the static switch field. This paper deals with the problem areas related to the development of ac and dc RPCs capable of withstanding adverse aircraft environments. The development has resulted in circuits with performance characteristics superior to previous technology without sacrifice of the three most important parameters: size, weight, and cost. (Author)

A71-35783 Some systems aspects of random access signaling. Darlow G. Botha (Texas Instruments, Inc., Dallas, Tex.). In NAECON '71, Institute of Electrical and Electronics Engineers, National Aerospace Electronics Conference, Dayton, Ohio, May 17-19, 1971, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 234-239. Research supported by Texas Instruments, Inc.

Some aspects of the application of a random access signaling system to an aircraft control system are discussed. A model of the radio environment is described and the model parameters related to the control system requirements. The model shows that, for simple time-frequency matrix signals, the number of system accesses is optimized when individual signals are transmitted with a redundancy of 7 to 19, with maximum randomness in the signal. This optimum corresponds to a total system data rate of 0.025 bits per second per cycle of system spectrum allocation. The implications of the principle of random access signaling for the control system are discussed: the allocation of system capacity to individual terminals, the utilization of the individual terminal allocation for maximum flexibility, some technology implications of signal design parameter choice, and how the principle offers potential for control system improvements, including compatibility with existing systems. (Author)

A71-35789 * A digital V-O-R navigation converter. C. Raymond Somerlock and John C. Lyons (NASA, Goddard Space Flight Center, Greenbelt, Md.). In NAECON '71, Institute of Electrical and Electronics Engineers, National Aerospace Electronics Conference, Dayton, Ohio, May 17-19, 1971, Proceedings.

New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 271-274.

The V-O-R indicator consists of a custom designed large scale MOS integrated circuit (IC) and several commercially available IC's to process the V-O-R measurement digitally and to present the pilot with a numeric hands-off presentation of his V-O-R radial. Since the phase delay measurement is made directly with digital techniques, no null indicators or resolvers are required, and all scale reading errors are eliminated. Accuracy, size, weight, and cost are all comparable to, or better than, the standard design. M. M.

A71-35799 A new approach to the calculation of transonic flows. J. C. Crown (Indiana University, Purdue University, Indianapolis, Ind.). *SIAM Journal on Applied Mathematics*, vol. 20, June 1971, p. 677-697. 22 refs. USAF-supported research.

Description of a mesh method for obtaining supercritical flows when the shock wave is at the trailing edge. Essential in this method is the introduction of a transonic flow function into exact inviscid flow equations, a procedure facilitating an appropriate representation of two-dimensional and axisymmetrical flows and, thus, the solution of transonic flow problems. Flow patterns with a normal shock wave or an oblique shock at the trailing edge can be treated by this method. Sample results are given for a circular arc airfoil at zero incidence. V. Z.

A71-35811 Determining loadability through system simulation. M. J. Coulter (Douglas Aircraft Co., Long Beach, Calif.). *Society of Aeronautical Weight Engineers, Annual Conference, 30th, Newport Beach, Calif., May 3-5, 1971, Paper 900*. 6 p.

Description of methods that can be used to evaluate proposed systems. The proposal chosen as an example considers potential cost savings by using onboard weight and balance equipment in conjunction with a fully mechanized cargo pallet transfer system. This loading system is evaluated through a wide range of parameters by means of stochastic processes in computer-based simulation models. The modeling techniques described may have application to current operational analyses. These could be evaluations of comparative loadability characteristics of different aircraft, or studies of the effect on loadability due to changes in balance restrictions for a particular aircraft. Potential applications of balance analyses of this type should also be considered as part of overall studies of complete cargo handling systems. (Author)

A71-35812 The administration of a cost/weight tradeoff program. G. W. Schmiedeknecht (Douglas Aircraft Co., Long Beach, Calif.). *Society of Aeronautical Weight Engineers, Annual Conference, 30th, Newport Beach, Calif., May 3-5, 1971, Paper 899*. 19 p.

This paper presents the administrative techniques of a cost/weight tradeoff program for a modern jet transport airplane. It introduces the concept and philosophy of using a defined cost/weight value as part of basic design criteria and discusses the full scope of a program to assure its overall application to vehicle design. The role of Management and Weight Engineering in Weight Reduction Programs is discussed in detail. Particular emphasis is placed on the concept of generating and maintaining a large number of weight saving ideas from which Management can select the type and amount of weight reduction that appears desirable for meeting weight guarantees and the competition. Procedures for converting weight saving ideas into actual hardware weight reductions are presented in outline form. Problems associated with assuring weight optimization of subcontract and vendor products are also discussed in detail. (Author)

A71-35813 Learning to live with the OBAWS. Alexander M Filipov (BLH Electronics, Inc., Waltham, Mass.) *Society of Aeronautical Weight Engineers, Annual Conference, 30th, Newport Beach, Calif., May 3-5, 1971, Paper 897.* 13 p.

Study of the sources and magnitudes of errors in Boeing 747 static aircraft weight values obtained by means of the on-board aircraft weighing system (OBAWS) and by manual calculations yielding manifest values. Sixty-two sets of data, collected from forty-eight aircraft, have been analyzed. Comparisons of OBAWS and manifest values for fifty-one sets of data, taken from thirty-six of the forty-eight aircraft, indicate that the distribution of discrepancies between OBAWS and manifest values has a standard deviation of plus or minus 1.07% of full scale, or plus or minus 7,597 pounds. Formal tests made on the 747-100 aircraft indicate that OBAWS can be expected to meet targeted accuracy requirements under normal operating conditions. M V E

A71-35814 Weighing in place. J R McCarty (United Air Lines, Inc., San Francisco, Calif.) *Society of Aeronautical Weight Engineers, Annual Conference, 30th, Newport Beach, Calif., May 3-5, 1971, Paper 898.* 7 p.

Discussion of the implementation of an idea to permit the weighing of an aircraft, utilizing load cells, while it remains on jacks during an overhaul at maintenance operation. Fixtures are threaded onto the screw extension of the standard aircraft tripod jack and become a part of the jack. When it is time to weigh the aircraft the small jacks and load cells are inserted into the fixtures, the aircraft is raised slightly, approximately 1/32 inch, transferring the weight to the load cells, and the weight readings are taken. G R

A71-35815 Non optimum factor and preliminary weight estimation of a boron composite wing structure. Donald J Lamorte (Grumman Aerospace Corp., Bethpage, N.Y.) *Society of Aeronautical Weight Engineers, Annual Conference, 30th, Newport Beach, Calif., May 3-5, 1971, Paper 891.* 19 p. Contract No AF 33(615)-68-C-1301

A rapid method is described for sizing boron-epoxy laminates for purposes of preliminary design. A comparison is made of the weights of a wing box beam using this approach and the weights of an actual wing box that was designed, fabricated, and tested. On this basis, a nonoptimum factor of 1.6 is derived. This compares quite favorably with the nonoptimum factors of approximately 1.5 for aluminum and titanium wings. M V E

A71-35816 The STAN/MASS system of determining aircraft weight and balance. Barry J Hawkins (Fairchild Camera and Instrument Corp., Commack, N.Y.) *Society of Aeronautical Weight Engineers, Annual Conference, 30th, Newport Beach, Calif., May 3-5, 1971, Paper 896.* 13 p.

The STAN-MASS system is presently installed on a USAF C-7A aircraft and an airline 727B. The MASS system provides the means of essentially eliminating landing gear strut friction without taxiing the aircraft. The basic concept of Integral Weight and Balance Systems (IWBS) is discussed together with their basic design requirement and their ultimate future. The various factors examined could be of help in the decision of an airline whether to select an IWBS. G R

A71-35817 V/STOL airplanes with vectored thrust propulsion-systems. Ted J Graham (McDonnell Aircraft Co., St. Louis, Mo.) *Society of Aeronautical Weight Engineers, Annual Conference, 30th, Newport Beach, Calif., May 3-5, 1971, Paper 894.* 15 p.

Some basic V/STOL propulsion systems are compared with the vectored thrust concept, and special design considerations of

V/STOL aircraft with respect to weight and balance, typified by the vectored thrust design are examined. The special character of these design considerations is determined by the pronounced effect of small changes in the weight and center of the gravity-lift-thrust relationship on the performance. The competitive stature of the vectored thrust V/STOL with a conventional takeoff and landing aircraft with short field capability is considered. V/STOL vectored thrust aircraft are competitive in the Close Air Support role. The lower the takeoff and landing distance becomes, the greater is the competitiveness of the V/STOL vectored thrust aircraft. G.R

A71-35818 The influence of composite materials on aircraft weight, design and performance. J. E. Augustus (McDonnell Aircraft Co., St. Louis, Mo.) *Society of Aeronautical Weight Engineers, Annual Conference, 30th, Newport Beach, Calif., May 3-5, 1971, Paper 888.* 23 p. 8 refs.

Discussion of the various applications of composites on present and future aircraft designs intended to operate in the Mach 2 to Mach 4.5 range. Parametric comparisons for near-term and future aircraft are presented. These parametrics illustrate weight and performance results with respect to various applications of composites as compared with all-metal aircraft structural concepts and designs. All-metal aircraft for the future, which are on an equal basis with composite aircraft, are considered. Major emphasis is orientated toward the advantages of future aircraft concepts designed with composites in their initial or preliminary design stages. F R L

A71-35819 Weight prediction techniques and trends for composite material structure. Robert J Taylor (McDonnell Aircraft Co., St. Louis, Mo.) *Society of Aeronautical Weight Engineers, Annual Conference, 30th, Newport Beach, Calif., May 3-5, 1971, Paper 887.* 20 p. 24 refs.

Study of the weight reduction potential of advanced composite materials in aerospace structures. No other material combines such high strength and stiffness with ease of fabrication. Use of boron/epoxy on the F-4 rudder saved 16.2 lb of structure and 6.3 lb of balance weights for a 35% saving. Most of the hardware development programs achieved weight savings of about 30%, which is in agreement with most of the analytical studies. It is considered that maximum weight savings from composites will occur in uniaxially loaded struts and/or trusses and in stiffness-critical components. A weight estimation technique is proposed which first estimates the structural weight as though it were aluminum and then modifies the estimate through several factors, accounting for the different mechanical properties and construction techniques, to arrive at a composite material structural weight. F.R L

A71-35824 A new design weight and center-of-gravity determining fixture. Donald J Williams and Ronald N. Cazier (Thiokol Chemical Corp., Brigham City, Utah). *Society of Aeronautical Weight Engineers, Annual Conference, 30th, Newport Beach, Calif., May 3-5, 1971, Paper 879.* 37 p.

Description of the equipment, principle of operation, calibration data and techniques, accuracy, errors, and repeatability of the model WCG-91-2-10K mass and CG determining system. The system is the largest device ever built which uses a mechanical beam balance for measuring mass and a separate and distinct system composed mainly of two electronic load cells for measuring CG moment. The device measures mass within an accuracy of 0.032% of applied load over a range as wide as 500 through 10,000 lb. The CG of the load can be measured by this new fixture to within 0.013 in (longitudinal) and 0.005 in (lateral and vertical). The fixture is versatile, in that it will accept rocket motors in both the horizontal and vertical positions and any other object not exceeding the gross weight and dimensional limitations of the system. M M

A71-35825 Design and weight aspects of advanced composites in complex fuselage structures D L Reed and F. Olson (General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.) *Society of Aeronautical Weight Engineers, Annual Conference, 30th, Newport Beach, Calif., May 3-5, 1971, Paper 889* 35 p Contract No AF 33(615)-69-C-1494

This paper describes the design, analysis and testing of a full-scale section of F-111 aft fuselage constructed from a variety of advance composite materials. This work represents the first application of advanced composites to complex fuselage structure. Maximum utilization of composites was maintained in both the shell structure and substructure. A wide variety of advanced composites and their applications were evaluated in a design and fabrication effort. A 160 inch full scale static test component was designed, fabricated and tested to destruction. Fourteen subassemblies of frames and panels were fabricated and assembled into a 920 pound component utilizing 460 pounds of advanced composite materials. Static test of the part included loading in bending with simultaneous application of internal pressure. Analytical predictions were obtained with a finite element simulation of the primary structure. Deflection gauge and strain gauge data showed excellent agreement with analytically predicted results. Weight savings of up to 29 percent were obtained on various elements of the structure. An overall weight savings of 18 percent with respect to equivalent metallic structure was realized (Author)

A71-35826 Analytical weight determination of articulated main rotor blades. James R. Neff (Hughes Tool Co., Culver City, Calif.) *Society of Aeronautical Weight Engineers, Annual Conference, 30th, Newport Beach, Calif., May 3-5, 1971, Paper 893*. 37 p 5 refs

This paper develops a method for estimating the weight of articulated main rotor blades. The results of the method should be suitable for use in preliminary design and weight evaluation, particularly in the case where parametric design studies are performed to study weight and performance tradeoff trends. An approximate expression for blade running weight in terms of performance and geometric parameters is presented. A method of estimating antinode weights required to achieve a specified first-mode flapwise natural frequency is included so that total blade weight may be obtained. A computer program for making a more comprehensive (but still approximate) estimate of blade weight, blade section structural proportions, and section properties useful for subsequent detailed analyses is presented. These results should be useful for establishing initial values of blade properties to use in comprehensive dynamic and structural programs necessary for final substantiation, the program is brief enough to be a practical one for use in parametric studies. The method presented is limited to articulated, shaft-driven main rotor blades having performance capabilities within current conventional helicopter limitations (Author)

A71-35827 Testing of two integral weight and balance systems on the C-7A. Edward Low (USAF, Washington, D.C.) *Society of Aeronautical Weight Engineers, Annual Conference, 30th, Newport Beach, Calif., May 3-5, 1971, Paper 881* 10 p

Description of the features, installation and maintenance problems, as well as requirements and testing of a strut pressure system and an axle strain gauge installed in the DeHavilland C-7A. All the systems had difficulty compensating for slope. After the hydraulic pump was modified, the strut pressure system met most of the requirements. Without some agitation to reduce strut friction error, it exceeded limits. The axle strain gauge system output was limited by shunting of the load away from the axle. It was very sensitive to weight changes and external forces, yet appeared to shift over a period of time. A need exists for weight and balance systems but it is suggested that these be carefully matched to the aircraft. It is pointed out that reliability should receive more emphasis now placed on accuracy M M

A71-35899 # Age of the RPV William A. Anderson (Teledyne Ryan Aeronautical, San Diego, Calif.) *Teledyne Ryan Aeronautical Reporter*, vol. 32, Summer 1971, p. 2-9

Evaluation of remotely piloted vehicles (RPV), the development of which has made possible a high degree of 'pilot' participation in areas where he functions best. The RPV concept is being considered for missions such as air superiority and weapons delivery, conducted in severely hostile environments. In these applications the goal is to maintain the advantages of manned flight through use of new sensors, data links, computers, and display systems without the disadvantages, such as life support systems, physical limitations, flight safety considerations, and loss of life F R L

A71-35904 Air-cooling of a turbine blade. Tsuyoshi Hiroki (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo, Japan) *IHI Engineering Review*, vol. 4, Mar 1971, p. 17-24

An air-cooled turbine blade was designed for the first stage turbine of a fan-jet at a turbine inlet temperature of 1150 C. The rotor blade was cooled by means of a number of straight holes. The nozzle vane was cooled by air impinging perpendicularly on the cooling surfaces. Two-dimensional cascade tests were carried out to obtain the heat transfer data, cooling efficiency, and the temperature distribution within the blade sections. It is concluded that the temperature distribution of the nozzle vane must be improved although the mean vane temperature reached the intended value G R

A71-35923 # Formation flight technology. T. K. Speer, E. C. Mills, and J. L. Tate (Lockheed-Georgia Co., Marietta, Ga.) *Aircraft Engineering*, vol. 43, July 1971, p. 4-8.

The evolution of formation flight technology is briefly reviewed, and the major characteristics are discussed of three specific station-keeping concepts developed since 1963. Results of detailed simulation studies of the dynamic station keeping geometry are presented in the form of fundamental formation flight stability criteria. Various approaches to further systems refinement are evaluated in terms of their assets and liabilities. The extension of present-day technology to development of formation flight systems for short range aircraft such as helicopters and V/STOL transports is considered M.V.E.

A71-35924 # Increasing responsibility for skilled men. E. Gregory *Aircraft Engineering*, vol. 43, July 1971, p. 11-13

Review of the procedures adopted within BEA in formulating and negotiating the second of the two complementary three-year agreements, the first in 1964/1965 and the second in 1968/1969. These procedures reflect current thinking concerning productivity agreements in industry which, it is felt, should be negotiated on a plant basis, and not on an industry-wide one, with the active participation of the staff in order that the deal gain acceptance and fulfill its promise. The development and negotiation of the 1969 agreement are described for each of the various categories of tradesmen and for the maintenance workers and storekeepers M V E

A71-35925 # Prediction of wing group weight for preliminary design. E. Torenbeek (Delft, Technische Hogeschool, Delft, Netherlands) *Aircraft Engineering*, vol. 43, July 1971, p. 16, 17, 20, 21. 8 refs.

A semiempirical relationship is derived for the structural weight of wings, applicable to a wide range of subsonic aircraft. The method is based on a generalized expression for the material required to resist the root bending moment due to wing lift in a specified flight condition. Appropriate factors make the result applicable to cantilever and braced wings, for passenger and general aviation aircraft

and for freighters. An assessment of the accuracy, based on actual wing weights of 46 aircraft, indicates that a standard deviation of 9.64 per cent is achieved. The weight formula presented allows for the effects of variations in the main wing dimensions and operational limits of the airplane and is therefore suited to parametric design studies. (Author)

A71-35995 Lockheed L-1011 - A new jumbo jet. Richard W. Schulz. *Airport Forum*, no. 2, 1971, p. 5-14. In English and German

The L-1011 TriStar incorporates many design features which enhance its acceptability into the world's airport system and optimize ground handling operations. The aircraft is designed to carry from 250 to 400 passengers. Favorable economics of the aircraft permit it to be used on either short or long segments and to operate in and out of medium size airports as well as major hubs. The L-1011 is comparable in size to most of the larger aircraft in operation. It is considerably smaller in all respects than the Boeing 747. The general layout of the aircraft is discussed together with the power plant, and aspects of passenger, cargo and baggage handling, fueling, and galley servicing. G R.

A71-35996 Equipped for the seventies - Basle-Mulhouse Airport. Theodor Stauffer (Flughafen Basel-Mulhausen, France). *Airport Forum*, no. 2, 1971, p. 17-21, 23, 24. In English and German

France and Switzerland began the construction of provisional runways and buildings of the airport in 1946, on French territory near the Basle frontier. Since 1953 the Basle-Mulhouse airport is operated as a binational facility. Under the intergovernmental convention, the Swiss must be able to use the airport as if it were a Swiss airport, and the French as if it were a French one. The traffic structure of the airport is examined, and an account of the new buildings is given. Questions of future development are discussed giving attention to a lengthening of the runway. G R.

A71-35997 Narita - Tokyo's new airport. Hirofumi Iwata (New Tokyo International Airport Corp., Narita, Japan). *Airport Forum*, no. 2, 1971, p. 34-40, 42, 43. In English and German

An intensive survey of 20 possible sites for a second international airport was carried out in 1965. In July 1966 the government finally designated the new airport site at Sanrizuka, by the city of Narita. Problems connected with the distance of the airport from the city center of Tokyo will be solved by the development of faster transportation. The runway system will comprise two parallel runways 13,100 ft and 8200 ft long, and a 10,500-ft crosswind runway intersecting the main runway. Each runway will have two parallel taxiways in order to permit high-speed handling of aircraft on the ground. Air navigation aids such as ILS, VOR-DME, NDB, ASR/SSR, lighting and other visual aids will be installed. Aspects of passenger and aircraft handling are discussed, and questions of ATC, access to the airport and freight handling are considered. G R.

A71-35998 New navigation and traffic control systems. Hans-Jurgen Rieks. *Airport Forum*, no. 2, 1971, p. 49-54, 56, 58-60. In English and German.

It was necessary, in the interests of flight safety, to create separate traffic zones in which the various aircraft covered by a common control system could operate. This led to the establishment of controlled and uncontrolled airspace. It is pointed out that because of air traffic growth rates very careful planning of effective

procedures and systems will be needed if the air traffic volume of the coming decades is to be handled with at least the present degree of safety. Plans for taking steps to cope with the increased air traffic are discussed. A systems analysis which is initially based on the structure of the airspace is considered, and possible means of increasing capacity are examined giving particular attention to Western Europe and the Atlantic area. Requirements for an ILS successor are discussed together with the advantages of area navigation. G R.

A71-36000 Design of asphalt pavements for heavy aircraft. John M. Edwards (Shell International Petroleum Co., Ltd., London, England) and Cornelius P. Valkering (Koninklijke Shell Laboratory, Amsterdam, Netherlands). *Airport Forum*, no. 2, 1971, p. 75-78, 80-82, 84, 85. 15 refs. In English and German

It is pointed out that analytical methods of design have been restricted to the effects of single wheels. It is doubtful whether existing methods are now acceptable in connection with the designing of pavements for new multiwheel aircraft. To meet the need for a more realistic method of assessing the stress distribution below the wheel arrangements of these aircraft, Shell has developed a computer program named BISTRO. Probably the most widely accepted method of pavement design is based on the CBR (California Bearing Ratio) of the soil. However, this approach does not take into account the effect on stress distribution within the structure of using construction materials other than unbound aggregates. A more fundamental method to overcome these shortcomings is discussed, giving attention to a three-layer system. G R.

A71-36017 # Using the ONERA/S4MA hypersonic wind tunnel for supersonic combustion ramjet tests. C. Soulier and J. Laverre (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). (*Supersonic Tunnel Association, Meeting, 35th, Dallas, Tex., Mar. 8, 9, 1971*) ONERA, TP no. 924, 1971. 11 p. 8 refs.

Review of the design and operation of the heater and Mach 6 nozzle of the S4MA wind tunnel, and description of the modifications the heater and nozzle underwent in their adaptation for testing a supersonic combustion chamber of a hydrogen burning ramjet engine. These modifications are shown to include the replacement of the aerodynamic nozzle by the combustion chamber to be tested. The chamber is supplied through a duct in such a manner that velocity, temperature, and pressure conditions at the engine inlet are the same as those in operation in a ramjet flying at Mach 6 at 30 km altitude. M V E.

A71-36020 # Study of fluctuations of wall pressure in transonic flow on a cone-cylinder body with a narrowed rear body. (*Etude des fluctuations de pression pariétales, en écoulement transsonique, sur ensemble cone-cylindre présentant un rétreint*). Alain Bourguin (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). (*International Union of Theoretical and Applied Mechanics, Symposium sur les Couches Limites Instationnaires, Quebec, Canada, May 24-28, 1971*.) ONERA, TP no. 942, 1971. 31 p. 7 refs. In French

Experimental study of the transonic buffeting environment of a cone-cylinder-cone missile-type body in the Mach number range between about 0.7 to about 1.1. The experiments were conducted in the S2MA transonic wind tunnel at ONERA to determine the distribution of static and fluctuating pressures on the walls of two perfectly rigid and fixed models of different scale. Spectral analysis of the data and visualization of the near flow field by shadowgraphs were performed. High intensity fluctuating pressures were found at the rear of the models, mainly at high subsonic Mach number (about 0.9). This is due to the separation of the flow and the instability of the shock wave position. RMS levels of the order of 168 dB and an

increase of the low frequency content were then obtained. The effects of model scale, angle of attack, dynamic pressure, and Reynolds number were studied. Generalized nondimensional spectra make it possible to put confidence in application of these results to such full-scale missiles. F R.L.

A71-36021 # Transonic testing of the air intake and afterbody of an engine nacelle (*Entrée d'air et arrière-corps de fuselage-moteur en transsonique*). Jacky Leynaert (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France) (*NATO, AGARD, Facilities and Techniques for Aerodynamic Testing of Transonic Speeds and High Reynolds Numbers, Göttingen, West Germany, Apr. 26-28, 1971.*) ONERA, TP no 943, 1971. 11 p. In French.

Study of a double-flux engine nacelle at high subsonic Mach numbers and high Reynolds numbers, using separate models for the air intake and the afterbody. The afterbody test shows that the conditions of variable jets do not react significantly on the upstream flow around the nacelle intake except in the immediate vicinity of the exhaust. This justifies the large-scale study of the air intake with a model supported downstream by a cylindrical tube replacing the jet. Similarly, mass-flow rate variations of the air intake do not react on the flow around the afterbody. This allows study of the afterbody mounted on a sting located upstream. F R.L.

A71-36037 * # Sting-free drag measurements on ellipsoidal cylinders at transition Reynolds numbers. M. Judd, M. Vlainac, and E. E. Covert (MIT, Cambridge, Mass.) *Journal of Fluid Mechanics*, vol. 48, July 28, 1971, p. 353-364. 12 refs. Contract No. NAS 1-8658

The drag coefficient for a family of axially symmetric ellipses of fineness ratio 4, 5, and 8 was measured for Reynolds numbers up to 1,000,000. The drag data reported were obtained by suspending ellipsoidal models in a subsonic wind tunnel by means of a magnetic balance and suspension system. The wind tunnel interference effects were determined by cross plotting the measured drag coefficient, at constant Reynolds number, against model size. All the models had a similar smooth finish. G.R.

A71-36061 Some considerations in the development of a holographic display for a blind landing system. William A. Shapiro, Ernest J. Lademann, and Charles J. Kramer (Bendix Corp., Navigation and Control Div., Teterboro, N.J.) In *Photo-optical instrumentation for the 70's*, Society of Photo-optical Instrumentation Engineers, Annual Technical Symposium, 15th, Anaheim, Calif., September 14-17, 1970, Proceedings.

Symposium co-sponsored by the U.S. Air Force and the U.S. Army Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers (SPIE Annual Technical Symposium Proceedings Volume 3), 1971, p. 123-128.

Description of a holographic system which provides an image perspective variable over a wide field of view. The image is two-dimensional and can be used as the input in optical systems corrected for only one plane. The method used for hologram manipulation is very effective in achieving maximum hologram efficiency in that it uses a fixed relation of reference wave inclination and shape to the hologram surface. The use of narrow-beam reconstruction facilitates the matching of the reference wavefront and permits the applications of either a collimated laser beam with an 'unrolled' hologram or a cylindrical-section beam with constant parameters. V.Z.

A71-36118 # Interaction between an underexpanded jet and an oncoming rated supersonic jet (*Vzaimodeistvie nedorasshirennoi strui so vstrechnoi sverkhzvukovoi raschetnoi struei*). O. S. Zelenkov

In *Gasdynamics and heat transfer*. Number 2 (*Gazodinamika i teploobmen*. Number 2). Edited by I. P. Ginzburg. Leningrad, Izdatel'stvo Leningradskogo Universiteta (Leningradskii Gosudarstvennyi Universitet, Uchenye Zapiski, No. 357, Seriya Matematicheskikh Nauk, No. 46), 1970, p. 81-91. In Russian.

Photographic study of colliding underexpanded and normally expanded supersonic jets in a two-wind-tunnel assembly with a static working pressure equal to the atmospheric pressure. Axisymmetrical conical nozzles with a small aperture half-angle are used for obtaining underexpanded jets. Expressions are given for the Mach number on underexpanded jet axes in front of central shock waves and for positions of the shock waves. It is shown that in the general case the contact surface represents a portion of a spherical surface whose curvature is a function of the ratio between the maximum underexpanded jet diameter and the rated jet diameter. V.Z.

A71-36122 # Acoustic emission of a supersonic jet toward the nozzle exit section for various ratios of active to passive pressure (*Akusticheskoe izluchenie sverkhzvukovoi strui v storonu sreza sopla pri razlichnykh rezhimakh nerashchetnosti*). V. D. Belenkov. In *Gasdynamics and heat transfer*. Number 2 (*Gazodinamika i teploobmen*. Number 2). Edited by I. P. Ginzburg. Leningrad, Izdatel'stvo Leningradskogo Universiteta (Leningradskii Gosudarstvennyi Universitet, Uchenye Zapiski, No. 357, Seriya Matematicheskikh Nauk, No. 46), 1970, p. 119-124. In Russian.

Pressure pulsations at points close to the nozzle exit section were studied in an open-jet wind tunnel, at a Mach number of 2 at the nozzle. The nozzle diameter was 16 mm, and the ratio of active to passive pressure varied between 0.9 and 6.2. The pressure pulsations at the points investigated are caused by sound radiation of the jet. This radiation has the nature of a discrete tone, whose source is localized at the initial portion of the jet. The frequency of the discrete tone is plotted for various conditions at the nozzle exit section. Diagrams showing the level of the pressure pulsations as a function of the ratio of active to passive pressure are presented. V.P.

A71-36134 # Investigation of supersonic flow around delta wings with forced asymmetry, taking into account flow separation at the leading edges (*Studiul scurgerii supersonice in jurul aripilor delta cu antisimetrie forțată ținând seama de desprinderea curentului la bordurile de atac*). Șt. Staicu (București, Institutul Politehnic Gheorghe Gheorghiu-Dej, Bucharest, Rumania) *Studii și Cercetări de Mecanică Aplicată*, vol. 30, no. 2, 1971, p. 431-452. 12 refs. In Rumanian.

The asymmetric distribution of the incidences or vertical velocities corresponds to that of a forced asymmetrical curved delta wing according to a linear function or asymmetrical deflection. Considering a slender fictitious wing equivalent to a real wing from the aerodynamic standpoint, the pressures distribution and aerodynamic characteristics of the wing are determined. M.M.

A71-36175 Safety in air transportation over the years (*Eighth Wings Club 'Sight' Lecture*). C. R. Smith. New York, Wings Club, 1971. 36 p.

Review of the processes by which the current high level of air transport safety has been achieved, the best assurance for continued safety being the determination of aviation personnel that nothing will be left undone. Better knowledge of weather formation has been of major importance. Developments in instrumentation, radio aids, aircraft structures, and powerplants are outlined. An appendix discusses aircraft icing, the problems of the piston engine, fire hazards, metal fatigue, and training. F.R.L.

A71-36176 # Determination of the stability conditions of composite maneuvers of a high-speed aircraft by Liapunov's direct method (Opredelenie uslovii ustoychivosti kombinirovannykh manevrov skorostnogo samoleta priamym metodom Liapunova). Iozef Kudrna (Výzkumný a Zkušební Letecký Ústav, Prague, Czechoslovakia). (National Conference on Applied Mechanics, Bucharest, Rumania, June 23-27, 1969.) *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée*, vol 16, no. 3, 1971, p. 463-482. 6 refs. In Russian.

Study of the stability of aircraft maneuvers determined by a constant angular pitching velocity, a constant angular velocity of rotation relative to the flight speed vector, a constant angle of attack, a zero sideslip angle, and a constant flight speed. This motion is called the unperturbed motion. The perturbed motion is described by a system of five differential equations, three of which are linear and two nonlinear. Liapunov's direct method is used to study the stability of the maneuvers. The stability conditions obtained for the composite maneuvers are represented in the form of regions of admissible values of the aerodynamic derivatives, and in the case where these derivatives have constant values - also in the form of regions of the square of the angular rolling velocity and the increment of the vertical g-force. A.B.K.

A71-36180 # Causes of the siren wail in the axial stage of a turbomachine (Ursachen des Sirenenheuels in der axialen Stufe einer Schaufelmaschine). Z. Moravec (Státní Výzkumný Ústav Konstrukce Strojů, Běchovice, Czechoslovakia). (National Conference on Applied Mechanics, Bucharest, Rumania, June 23-27, 1969.) *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée*, vol 16, no. 3, 1971, p. 611-619. 7 refs. In German.

Study of a noise occurring in the axial stage of a turbine due to nonuniformity of the pressure fields behind the blade cascades resulting from the presence of the wake behind the blades. The noise in question is a siren noise typical of blade stages. It is shown that, owing to changes in the characteristic values of the incident flow on the blade cascade, changes in the flow around the blades of the following cascade occur and thus cause a variation in the pressures. The basic parameters of the blade stage are given in terms of the fluid flow rate and the work imparted to the stage by the rotating system at a given angular velocity. Certain relations between the basic geometry of an axial blade stage and the siren noise are investigated. A.B.K.

A71-36181 # Considerations on the thin delta wings with finite velocities at the leading edges. E. Carafoli and Șt. Staicu (București, Institutul Politehnic Gheorghe Gheorghiu-Dej, Bucharest, Rumania). *Revue Roumaine des Sciences Techniques, Série de Mécanique Appliquée*, vol 16, no. 3, 1971, p. 621-643. 6 refs.

Study of supersonic flows past delta wings deformed in such a way as to avoid the appearance of corner vortices. A comparison is made between a number of wing configurations with finite velocities at the leading edges, thus avoiding the appearance of corner vortices. The possibility of introducing appropriately inclined leading edge flaps to avoid the appearance of these vortices is considered, as well as the use of a wing with continuous variation of the incidence at the leading edges by deformation of the leading edge flaps or the use of a delta wing the entire surface of which is conically curved. The use of a symmetrically cambered and twisted delta wing or a third-order conical wing is also considered. A.B.K.

A71-36268 * # The flow of a laminar, incompressible jet along a parabola. A. Plotkin (Maryland, University, College Park, Md.). American Society of Mechanical Engineers, Paper no. 71-APM-MM, 1971, 5 p. 9 refs. Members, \$1.00, nonmembers, \$3.00. Grants No. N5G-398, No. NGR-21-002-266.

The flow of a laminar, incompressible jet along a parabola in the absence of an external stream is analyzed using the techniques of second-order boundary-layer theory. The first-order solution is the Glauert wall-jet solution. Second-order corrections in the jet due to the effects of curvature and displacement are obtained numerically after the external flow is corrected to account for the displacement effect. The shear stress at the wall is calculated and it appears that for values of the Reynolds number at which the governing equations are valid the jet does not separate from the parabola. (Author)

A71-36273 # Vertical and short takeoffs and landings of hybrid jet-lift airplanes. Aadu Karemaa (General Dynamics Corp., Convair Aerospace Div., San Diego, Calif.). *American Institute of Aeronautics and Astronautics, Aircraft Design and Operations Meeting, 3rd, Seattle, Wash., July 12-14, 1971, Paper 71-767*. 14 p. Members, \$1.50, nonmembers, \$2.00.

The relationship between wing area and lift engine bypass ratios is examined. It is pointed out that large bypass ratio lift engines or fans, although preferable from ground erosion and noise abatement standpoints, must be accompanied by relatively low wing loadings or sophisticated high-lift systems to permit transition to wing-borne flight at low speeds or before the ram drag from the vertical lift package becomes prohibitive. The wing aspect ratio and sweepback are other considerations that impact terminal area operations. Low aspect ratios and delta wings generally can be flown at higher angles of attack and, consequently, permit VTOL airplanes to make steeper approaches to landings. It is concluded that a safe and economical hybrid jet-lift V/STOL transport could be produced with the current technological basis. This airplane would incorporate lift jets or turbofans for lift augmentation during takeoffs and landings, using separate powerplants for cruise. Z.W.

A71-36275 # Development and performance of advanced composite structures (Second Annual Structures Design Lecture). George P. Peterson (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio). *American Institute of Aeronautics and Astronautics and American Society of Mechanical Engineers, Structures, Structural Dynamics and Materials Conference, 12th, Anaheim, Calif., Apr. 19-21, 1971, AIAA Paper 71-367*. 8 p. Members, \$1.50, nonmembers, \$2.00.

It is shown that substantial development progress was made in the application of composites to empennage structures and in wing, fuselage, aeropropulsion, and missile and space structures. Results are presented which indicate the performance and significant weight savings of the structural hardware developed to date. A perspective on the status of current and planned future efforts which will provide a broad application potential is discussed. Z.W.

A71-36301 International Conference on Numerical Methods in Fluid Dynamics, 2nd, University of California, Berkeley, Calif., September 15-19, 1970, Proceedings. Conference supported by the U.S. Air Force and the U.S. Navy. Edited by Maurice Holt (California, University, Berkeley, Calif.). Berlin and New York, Springer-Verlag (Lecture Notes in Physics Volume 8), 1971. 460 p. \$8.10. In English and French.

Topics cover numerical techniques, flow field calculations, and shock waves and aspects of turbulence including a nonlinear analysis of the shock profile in difference schemes and a heuristic approach to three-dimensional boundary layers. Methods for solving Navier-Stokes equations are also considered together with papers concerned with the investigation of incompressible flows.

G.R.

A71-36303 * The computation of supersonic flow fields about wing-body combinations by 'shock-capturing' finite difference techniques. Paul Kutler and Harvard Lomax (NASA, Ames Research Center, Moffett Field, Calif.) In International Conference on Numerical Methods in Fluid Dynamics, 2nd, University of California, Berkeley, Calif., September 15-19, 1970, Proceedings

Conference supported by the U.S. Air Force and the U.S. Navy. Edited by Maurice Holt Berlin and New York, Springer-Verlag (Lecture Notes in Physics Volume 8), 1971, p. 24-29. 13 refs

Three fundamental ways for improving the resolution of the shock position are examined, taking into account an increase of the order of the differencing scheme, an increase in the number of node points in the differencing mesh, and an adjustment of some parameter, or even the mesh itself. The methods considered are all outgrowths of Runge-Kutta techniques. To illustrate the power of shock-capturing methods over a wide range of applications, the results for four sets of computations are included. G.R.

A71-36311 Laminar flows past a flat plate at various angles of attack. Hans J. Lugt and Henry J. Haussling (U.S. Naval Material Command, Ship Research and Development Center, Washington, D.C.) In International Conference on Numerical Methods in Fluid Dynamics, 2nd, University of California, Berkeley, Calif., September 15-19, 1970, Proceedings

Conference supported by the U.S. Air Force and the U.S. Navy. Edited by Maurice Holt Berlin and New York, Springer-Verlag (Lecture Notes in Physics Volume 8), 1971, p. 78-83. 6 refs. Navy-sponsored research.

Derivation of numerical solutions by means of a stream function-vorticity formulation for laminar incompressible fluid flows past a flat plate at angles of attack of 0, 45, and 90 deg with Reynolds numbers of 30, 50, and 200. The cross section of the plate is elliptic, and the flow is assumed to be two-dimensional and time-dependent. Potential flow is selected as the initial condition. Asymptotic steady-state solutions have been obtained for the symmetric configurations with 0 and 90 deg angles of attack, whereas the 45 deg inclined plate always caused vortex shedding, even for Re as low as 30. The development of a Kármán vortex street for Re = 200 and an angle of attack of 45 deg is presented in detail. (Author)

A71-36325 Solution of the transonic potential equation using a mixed finite difference system. E. M. Murman and J. A. Krupp (Boeing Scientific Research Laboratories, Seattle, Wash.) In International Conference on Numerical Methods in Fluid Dynamics, 2nd, University of California, Berkeley, Calif., September 15-19, 1970, Proceedings

Conference supported by the U.S. Air Force and the U.S. Navy. Edited by Maurice Holt Berlin and New York, Springer-Verlag (Lecture Notes in Physics Volume 8), 1971, p. 199-206. 11 refs.

A new method is presented for numerically solving the transonic potential equation, including problems with embedded shock waves. Elementary concepts of finite difference techniques are combined to form a mixed finite difference system. Solutions are presented for flows past four transonic airfoils and for the structure of a caustic. The method is accurate, straightforward, and relatively fast. Z.W.

A71-36328 Some results of calculations of flows around conical bodies at large incidence angles. A. P. Bazzhin (Moskovskii Fiziko-Tekhnicheskii Institut, Moscow, USSR). In International Conference on Numerical Methods in Fluid Dynamics, 2nd, University of California, Berkeley, Calif., September 15-19, 1970, Proceedings

Conference supported by the U.S. Air Force and the U.S. Navy. Edited by Maurice Holt Berlin and New York, Springer-Verlag (Lecture Notes in Physics Volume 8), 1971, p. 223-229. 9 refs.

A procedure is described for calculating the dynamic parameters of a supersonic flow incident on a conical body at large angles of attack. A solution is obtained for the flowfield with the exception of a region above the body. It is shown that the entropy distribution around a circular cone undergoes changes when the angle of flow incidence is increased so that the thin surface entropy layers vanish when the incidence angles are very large. It is further shown that the strength of the arising conical shock wave depends on the cone geometry. V.Z.

A71-36330 Subcritical flows over two dimensional airfoils by a multistrip method of integral relations. R. E. Melnik and D. C. Ives (Grumman Aerospace Corp., Bethpage, N.Y.) In International Conference on Numerical Methods in Fluid Dynamics, 2nd, University of California, Berkeley, Calif., September 15-19, 1970, Proceedings

Conference supported by the U.S. Air Force and the U.S. Navy. Edited by Maurice Holt Berlin and New York, Springer-Verlag (Lecture Notes in Physics Volume 8), 1971, p. 243-251. 9 refs.

Exploration of the possibility of using Dorodnitsyn's method of integral relations (MIR) to treat the classical nonlinear flow problem of subsonic airfoils. The chief advantage of MIR is that, because a relatively coarse mesh can be taken across the flow field, useful solutions can be obtained with less computer time than might be required by other methods. In the study the MIR is programmed for an arbitrary number of strips, and solutions using up to five strips have been obtained in order to investigate the convergence properties of the method. The work reported is restricted to the subcritical and critical cases only. F.R.L.

A71-36339 The conical wing in hypersonic flow. A. L. Gonor, V. I. Lapygin, and N. A. Ostapenko (Akademiya Nauk SSSR, Institut Mekhaniki, Moscow, USSR). In: International Conference on Numerical Methods in Fluid Dynamics, 2nd, University of California, Berkeley, Calif., September 15-19, 1970, Proceedings

Conference supported by the U.S. Air Force and the U.S. Navy. Edited by Maurice Holt Berlin and New York, Springer-Verlag (Lecture Notes in Physics Volume 8), 1971, p. 320-334. 12 refs.

Consideration of supersonic and hypersonic flow past a V-shaped conical wing with a shock attached to the leading edge. Two approaches are developed for solution of the general problem. In the first a time-dependent method is used in which the difference scheme contains an artificial viscosity and the role of time is played by one of the space coordinates with respect to which the stationary system of the equations is hyperbolic. In the second approach a recently developed analytical method for investigation of hypersonic flow past triangular wings with supersonic leading edges is used. F.R.L.

A71-36346 # Airfield pavement systems. E. Lile Murphree, Jr. (U.S. Army, Construction Engineering Research Laboratory, Campaign, Ill.), Ronald W. Woodhead, and Robert H. Wortman (Illinois, University, Urbana, Ill.) (American Society of Civil Engineers, National Meeting on Transportation and Engineering, Boston, Mass., July 13-17, 1970) ASCE, Transportation Engineering Journal, vol. 97, Aug. 1971, p. 389-399. 22 refs.

The systems approach is applied to the problem of creating new airfields and modifying existing ones to handle bigger and heavier aircraft which may be expected to be in service by 1985. It is shown that present design techniques do not permit an aircraft/pavement economic tradeoff, nor do they explicitly consider all the functional requirements of the user. Lifetime management of the pavement can be planned and controlled with the aid of current modeling technology. The systems approach holds the key to an integrated plan for design, construction, operation, and maintenance of airfield pavements. V.P.

A71-36347 # V/STOL concepts in short haul air transport. Bernard L. Fry (Department of Transport, Ontario, Canada) and R. William DeDecker (Pan American World Airways, Inc., New York, N.Y.) (*American Society of Civil Engineers, National Meeting on Transportation and Engineering, Boston, Mass., July 13-17, 1970.*) *ASCE, Transportation Engineering Journal*, vol. 97, Aug. 1971, p. 411-419. 6 refs.

The relative merits of aircraft designed for field lengths from a few to 3000 ft are assessed with respect to direct operating cost, indirect operating cost, and V/STOL port amortization combined into a total ticket cost for profitable operation. A daily traffic flow of roughly 500 passengers arriving at a suburban terminal and 12,000 passengers arriving at a city terminal is considered. It is shown that ticket cost will not be greatly influenced by the number or length of runways or vehicle type for suburban operations alone, and that the number and length of runways has a considerable impact on ticket cost for close to city center operations, there being a distinct advantage for aircraft with less than 1000 ft takeoff and landing distance. V.P.

A71-36348 * # STOL passenger demand in underdeveloped areas. Jason C. Yu (Virginia Polytechnic Institute and State University, Blacksburg, Va.) *ASCE, Transportation Engineering Journal*, vol. 97, Aug. 1971, p. 475-490. 13 refs. Grant No. NGR-49-001-012.

The possibility of implementing an air transportation system that would boost the economy of underdeveloped areas (where ground transportation facilities are too costly owing to the rugged terrain) is considered. A travel demand model is employed to predict the passenger market potential of a preliminary STOL system. The results indicate that passenger service demand for a STOL system will be limited. However, greater demand will obviously come through lower system operating costs and improved terminal accessibility. V.P.

A71-36349 # Atlanta's instant runway. Robert W. Richards (Howard, Needles, Tammen and Bergendoff, and Robert Company Association, Atlanta, Ga.) (*American Society of Civil Engineers, National Meeting on Transportation and Engineering, Boston, Mass., July 13-17, 1970.*) *ASCE, Transportation Engineering Journal*, vol. 97, Aug. 1971, p. 491-500.

Equipment and techniques are discussed, using which a 10,000 ft long 150 ft wide runway and a parallel taxiway were removed and replaced in just 40 calendar days. The old runways consisted of a 9-in. concrete pavement over a 6-in. stone subbase. The new runway consists of a 16 to 20 in. concrete pavement over a 6-in. compacted aggregate subbase and 6 in. of cement stabilized subgrade soil. The new system includes a longitudinal and herringbone underdrain system. V.P.

A71-36361 * MSDS - An experimental 24-channel multi-spectral scanner system. Eugene M. Zaitzeff, Charles L. Wilson (Bendix Corp., Aerospace Systems Div., Ann Arbor, Mich.), and C. Laurence Korb (NASA, Manned Spacecraft Center, Earth Observation Div., Houston, Tex.). *IEEE Transactions on Geoscience Electronics*, vol. GE-9, July 1971, p. 114-120.

Description of a multispectral scanner which is being developed for a NASA C-130 earth-resources survey aircraft. The scanner will be capable of simultaneously viewing 24 wavelength bands in the range between 0.34 and 13 micrometers; it will have a spatial resolution of 2 mrad and an active scan of 80 deg. The spectral bands are formed by detector arrays in the focal plane of two grating spectrometers. All bands are radiometrically calibrated using field-filling sources that are viewed during the inactive part of the scan cycle. The scanner has been installed and test flown during the latter part of 1970, and will be delivered to NASA in the summer of 1971. M.M.

A71-36431 # Aerodynamic problems of hypersonic waveriders (Aerodynamische Probleme hypersonischer Wellenreiter). K. Kipke (Braunschweig, Technische Universität, Braunschweig, West Germany). In: Theoretical and experimental methods of flow mechanics with special allowance for reentry problems, Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Deutsche Gesellschaft für Luft- und Raumfahrt, and Hermann-Oberth-Gesellschaft, Course in Space Flight Techniques, 9th, Universität Göttingen, Göttingen, West Germany, March 1-5, 1971, Proceedings. Volume 3 (Theoretische und experimentelle Methoden der Strömungsmechanik unter besonderer Berücksichtigung der Wiedereintrittsprobleme, Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Deutsche Gesellschaft für Luft- und Raumfahrt, and Hermann-Oberth-Gesellschaft, Lehrgang für Raumfahrtstechnik, 9th, Universität Göttingen, Göttingen, West Germany, March 1-5, 1971, Vorträge Volume 3). Course supported by the Bundesministerium für Bildung und Wissenschaft. Porz-Wahn, West Germany, Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, 1971. 25 p. 39 refs. In German.

The fundamentals of designing a hypersonic aircraft which at Mach numbers between 10 and 16 can serve as a space shuttle and at lower Mach numbers as a transport aircraft are examined. The direct method of designing such an aircraft is shown to depend on the accuracy of the determination of the aerodynamic coefficients of a given hypersonic configuration and on the capability of obtaining an exact solution to the Navier-Stokes partial differential equations by a numerical difference technique for high Reynolds numbers (in order to determine the pressure and shear-stress distributions), neither of which is possible at this point. The determination of the aerodynamic behavior of a waverider by the indirect method in the case of viscous flow is examined, using the Caret-wing as an example. Three-component measurements performed with six different wings in a hypersonic wind tunnel are compared, and the pressure distributions and flow fields are examined. The temperature problem of a hypersonic aircraft is analyzed. V.P.

A71-36448 Pan American's planned maintenance control system. Sam Stallone (Pan American World Airways, Inc., Jamaica, N.Y.). In: Technology today and tomorrow, Canaveral Council of Technical Societies, Space Congress, 8th, Cocoa Beach, Fla., April 19-23, 1971, Proceedings. Volume 1. Edited by N. A. Stein. Cape Canaveral, Canaveral Council of Technical Societies, 1971, p. 2-35 to 2-40.

Review of the functions, design, and makeup of a maintenance control system (MCS) based on a modular development plan. MCS is a management information system that incorporates all the control functions of maintenance into an integrated operation. MCS encompasses 12 major functional subsystems supporting scheduling, forecasting, performance evaluation, modifications, and improvement functions at all levels of maintenance management from the production foreman to the vice-president. The objective of MCS is to develop a cost-effective system which links the functional entities of maintenance into a unified management control system and makes use of common data in its operation. M.V.E.

A71-36450 Progress in the dissipation of fog. Robert D. Fletcher (USAF, Air Weather Service, Scott AFB, Ill.). In: Technology today and tomorrow, Canaveral Council of Technical Societies, Space Congress, 8th, Cocoa Beach, Fla., April 19-23, 1971, Proceedings. Volume 1. Edited by N. A. Stein. Cape Canaveral, Canaveral Council of Technical Societies, 1971, p. 3-1 to 3-4. 5 refs.

Discussion of techniques for the dissipation of fogs consisting of liquid drops, either in a supercooled or in a 'warm' state. Operational programs conducted by U.S. commercial and military agencies in the dissipation of supercooled fog are shown to involve airborne

dissipation systems at Elmendorf Air Force Base, Alaska, and at U S. bases in Germany, as well as ground-based propane systems. Also reviewed are advances in warm-fog dissipation which are mostly in the research and development stage. The French jet-engine installation is noted, along with proposals for warm-fog dissipation by heat techniques prepared by several U S. commercial companies, and by helicopter downwash as advanced by the Air Force Cambridge Research Laboratories. Recent tests using hygroscopic materials are also discussed. M V E

A71-36464 Thermal ground testing of Concorde and Veras or improvement in French test methods and facilities. G L Leroy, N'Guyen (Société Nationale Industrielle Aérospatiale, Paris, France), M. Perrais (CEAT, France), and E. Loiseau (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). In *Technology today and tomorrow*, Canaveral Council of Technical Societies, Space Congress, 8th, Cocoa Beach, Fla., April 19-23, 1971, Proceedings Volume 1. Edited by N A Stein. Cape Canaveral, Canaveral Council of Technical Societies, 1971, p. 7-31 to 7-60.

Review of the two ground test programs of the Concorde and Veras. Emphasis is placed on the facility implementations due respectively to the static and fatigue testing of the Concorde in the heat environment and to the dynamic testing of Veras in high-level and transient-temperature conditions. Problems presented by the necessity that the ground testing facilities include most of the simulation requirements together in order to approximate in-flight behavior are discussed, together with future needs in the fields of cryogenics, acoustics, and automation. M M

A71-36479 The determination of avionics redundancy for minimum cost. Myron Kayton and William A. Klein (TRW Systems Group, Redondo Beach, Calif.). In *Technology today and tomorrow*, Canaveral Council of Technical Societies, Space Congress, 8th, Cocoa Beach, Fla., April 19-23, 1971, Proceedings Volume 1. Edited by N A Stein. Cape Canaveral, Canaveral Council of Technical Societies, 1971, p. 12-23 to 12-32.

Analysis of the level of redundancy of line replaceable units (LRUs) required for the Space Shuttle avionics system. A total cost to the program of each added LRU is calculated and the configuration that results in the lowest program cost is selected. The analysis includes the costs of developing and procuring hardware, and the annual maintenance expense. Improvement in reliability is quantified in terms of the reduced costs due to fewer lost vehicles and fewer missions where the payload cannot be delivered. The analysis allows a choice of high-reliability or low-reliability procurement policies for each LRU. The results show that triply redundant booster equipment and triply redundant orbiter equipment are most cost effective, except for one additional inertial platform and central computer in the orbiter. F R L

A71-36480 Control of space shuttle maintenance cost by the application of airline methods. R S Williams (Pan American World Airways, Inc., Jamaica, N.Y.). In *Technology today and tomorrow*, Canaveral Council of Technical Societies, Space Congress, 8th, Cocoa Beach, Fla., April 19-23, 1971, Proceedings Volume 1. Edited by N A Stein. Cape Canaveral, Canaveral Council of Technical Societies, 1971, p. 13-11 to 13-14.

Attempt to relate certain areas of similarity between space shuttle operation and airline operation. Airline experience indicates that the major areas which must be considered during preliminary design are fault detection and isolation, redundancy, maintainability, and a comprehensive maintenance program. The space shuttle must have as a design goal inclusion of on-board self-test equipment in all systems and components if maintenance cost and down time are to be minimized. System reliability through redundancy with a lower order of reliability can result in a lower acquisition and maintenance cost. F R L

A71-36488 Arrestment considerations for the space shuttle. Richard V. Parker (All American Engineering Co., Wilmington, Del.). In *Technology today and tomorrow*, Canaveral Council of Technical Societies, Space Congress, 8th, Cocoa Beach, Fla., April 19-23, 1971, Proceedings Volume 2. Edited by N A Stein. Cape Canaveral, Canaveral Council of Technical Societies, 1971, p. 7-69 to 7-80.

Discussion of the advisability and possibilities of providing overrun protection to landing space shuttle vehicles through application of emergency arrestment aids. The potential for an overrun of a landing space shuttle vehicle is believed to exist, and it is pointed out that the art of arresting an aircraft on a runway is highly developed and that equipment is available which is capable of arresting either the orbiter or the booster portions of the space shuttle. Three engagement methods (tailhook/cable, net, and landing gear/cable) are shown to be applicable, and the advantages and disadvantages of each are reviewed. It is concluded that an evaluation of the merits of overrun arrestment should be made a part of the space shuttle system's planning effort. M V E

A71-36493 The application of ranging techniques to navigation and traffic control. Philip M. Diamond (Aerospace Corp., El Segundo, Calif.). In *Technology today and tomorrow*, Canaveral Council of Technical Societies, Space Congress, 8th, Cocoa Beach, Fla., April 19-23, 1971, Proceedings Volume 2. Edited by N A Stein. Cape Canaveral, Canaveral Council of Technical Societies, 1971, p. 15-10 to 15-21, 15-23 to 15-29.

Discussion of advanced navigation and air traffic control requirements and possibilities. Because of significant advances in space technology and avionics, satellite-based systems to provide position-fixing data by means of ranging and range-differencing techniques, and to provide communications capability, are shown to be feasible and attractive, and to have unique technical and operational advantages. From a satellite and data processing point of view, it appears feasible to implement in the early 1980s a system which could provide surveillance data to the order of 100 feet in three dimensions, an emergency communications capability corresponding to the operational notion of intermittent positive control, and data for accurate autonomous navigation and blind landing. These capabilities would be available to any aircraft to an extent depending on its investment in avionics. M V E

A71-36497 Multiple tone generation by transonic compressors. D. Hawkings (Rolls-Royce, Ltd., Advanced Research Laboratory, Derby, England). (*British Acoustical Society and Royal Aeronautical Society, Aerodynamic Noise Symposium, Loughborough University of Technology, Loughborough, Leics., England, Sept. 14-17, 1970.*) *Journal of Sound and Vibration*, vol. 17, July 22, 1971, p. 241-250. 5 refs.

An axial flow compressor operating at relative tip speeds in excess of the speed of sound generates a multiple tone acoustic field. A theory is presented which explains this tone field in terms of the production and propagation of the shock waves associated with the supersonic elements of the blading. It is shown how the strengths and positions of these shock waves are sensitive to the small blade-to-blade differences found in practical builds. This causes the complete shock pattern to be unique to each compressor. The propagation of the shock waves along the inlet ducting is analyzed. This indicates that whilst the overall strength of the shock system decays, the relative differences between the shock waves are magnified in the propagation process. Ultimately, all similarity of the shock system to its original form is lost, and the steady rotation of the new shock system results in the multiple tone field. The analysis shows how features of the compressor design, as well as the degree of nonuniformity in the blade geometries, can influence the level and character of the radiated field. (Author)

A71-36498 Noise due to interaction of inlet turbulence with isolated stators and rotors. R. Mani (Massachusetts, University, Amherst, Mass.). *Journal of Sound and Vibration*, vol. 17, July 22, 1971, p. 251-260. 6 refs. NSF Grant No. GK-5215

Analytical study of the problem of sound generation due to free stream turbulence incident on a rotor or stator row. A linearized analysis is carried out with the blade rows being modeled as a cascade of flat plates. Only the dipole effect is considered. Expressions are obtained for the intensity spectrum of noise radiated upstream and downstream. The turbulence is assumed to be homogeneous, isotropic and stationary (weak), and characterized by a longitudinal velocity-correlation function of type $\exp(-r/L)$. The sound spectrum is found to depend on the intensity of turbulent kinetic energy incident on the row, axial flow Mach number, wheel tip Mach number, row solidity, and most importantly on the ratio of the length scale L of the turbulence to the transverse spacing D between the blades. The spectra for rotors are sharply peaked at the blade-passage frequency and its higher harmonics so long as L/D exceeds about 0.5. Below these values of L/D the spectra start broadening noticeably. Also for rotors, the sound power levels themselves increase with decreasing L/D . The spectra for stators simply exhibit the dominant turbulent frequency. Noise levels for scattering by a rotor are higher than for those by a stator. (Author)

A71-36508 Radio tracking of aircraft by means of two geostationary satellites (Localisation radioélectrique des aéronefs au moyen de deux satellites géostationnaires). J. Bensimon and M. Toussaint (Société d'Etude et d'Intégration de Systèmes Spatiaux, Courbevoie, Hauts-de-Seine, France). In: Space and communication Acquisition and transmission of data in space applications systems, Union des Associations Techniques Internationales and Société Française des Electroniciens et des Radioélectriciens, International Conference, Paris, France, March 29-April 2, 1971, Communications Volume 1 (L'espace et la communication. Collecte et transmission de l'information dans les systèmes spatiaux d'application, Union des Associations Techniques Internationales and Société Française des Electroniciens et des Radioélectriciens, Colloque International, Paris, France, March 29-April 2, 1971, Communications Volume 1).

Colloquium co-sponsored by the Fédération Nationale des Industries Electroniques and the Centre National d'Etudes Spatiales. Paris, Comité d'Organisation du Colloque de Paris, 1971, p. 123-132. In French.

Study of the accuracy with which the ground terminal can know at any moment the location of an aircraft by means of radio signals emitted by the terminal and retransmitted by the aircraft via two geostationary satellites. The basic technique considered is that of 'tone ranging'. The location of the aircraft is determined from two distance measurements and one altitude measurement. After a description of the measurement and navigation errors, a parametric study is made of the tracking accuracy with the aid of the Kalman filter technique. A B K

A71-36509 Preliminary experiments in the air navigation aid satellite project (Expériences préliminaires au projet de satellites d'aide à la navigation aérienne). A. Cherubin and M. J. Beaucher (Centre National d'Etudes Spatiales, Brétigny-sur-Orge, Essonne, France). In: Space and communication: Acquisition and transmission of data in space applications systems, Union des Associations Techniques Internationales and Société Française des Electroniciens et des Radioélectriciens, International Conference, Paris, France, March 29-April 2, 1971, Communications Volume 1 (L'espace et la communication. Collecte et transmission de l'information dans les systèmes spatiaux d'application, Union des Associations Techniques Internationales and Société Française des Electroniciens et des Radioélectriciens, Colloque International, Paris, France, March 29-April 2, 1971, Communications Volume 1).

Colloquium co-sponsored by the Fédération Nationale des Industries Electroniques and the Centre National d'Etudes Spatiales. Paris,

Comité d'Organisation du Colloque de Paris, 1971, p. 133-143. In French.

Description of two groups of tests of aircraft onboard equipment used in connection with the Dioscures project. Both aircraft-to-aircraft and aircraft-to-balloon experiments on the onboard equipment are described, involving a preliminary evaluation of the operational qualities of the onboard equipment, an evaluation of the intelligibility of the audio links, an estimate of the random errors of the tracking system, and preliminary measurements of signal variations due to multiple-pass effects. A B K

A71-36510 Air traffic control satellite simulation experiment. D. L. Brown (ESRO, European Space Research and Technology Centre, Noordwijk, Netherlands). In: Space and communication Acquisition and transmission of data in space applications systems, Union des Associations Techniques Internationales and Société Française des Electroniciens et des Radioélectriciens, International Conference, Paris, France, March 29-April 2, 1971, Communications Volume 1 (L'espace et la communication. Collecte et transmission de l'information dans les systèmes spatiaux d'application, Union des Associations Techniques Internationales and Société Française des Electroniciens et des Radioélectriciens, Colloque International, Paris, France, March 29-April 2, 1971, Communications Volume 1).

Colloquium co-sponsored by the Fédération Nationale des Industries Electroniques and the Centre National d'Etudes Spatiales. Paris, Comité d'Organisation du Colloque de Paris, 1971, p. 144-154.

Description of the ESRO part of a joint air traffic control communication experiment for future L-band satellite use. The satellite-to-aircraft geometry was approximated by the use of stratospheric balloons to carry the signal repeater to an altitude of 38 km. The results of tests of some of the candidate analog communication systems which have been proposed for an L-band satellite ATC system for oceanic control are cited, including tests on techniques of voice transmission, data transmission, and distance measurement. A B K

A71-36511 Results of experiments in simulating a satellite-to-aircraft radio link at 1600 MHz (Résultats des expériences de simulation d'une liaison radioélectrique satellite-avion à 1600 MHz). M. Plantier (Secrétariat Général à l'Aviation Civile, Service Technique de la Navigation Aérienne, Paris, France). In: Space and communication: Acquisition and transmission of data in space applications systems, Union des Associations Techniques Internationales and Société Française des Electroniciens et des Radioélectriciens, International Conference, Paris, France, March 29-April 2, 1971, Communications Volume 1 (L'espace et la communication. Collecte et transmission de l'information dans les systèmes spatiaux d'application, Union des Associations Techniques Internationales and Société Française des Electroniciens et des Radioélectriciens, Colloque International, Paris, France, March 29-April 2, 1971, Communications Volume 1).

Colloquium co-sponsored by the Fédération Nationale des Industries Electroniques and the Centre National d'Etudes Spatiales. Paris, Comité d'Organisation du Colloque de Paris, 1971, p. 155-168. In French.

Description of experiments in simulating a satellite-to-aircraft radio link using Dioscures equipment in aircraft-to-aircraft and aircraft-to-balloon tests. Results from both types of tests are presented involving an evaluation of the operation of an electronic scanning antenna, measurements of the intelligibility of the audio links, measurements of the rate of data transmission, an evaluation of distance measurement accuracy, and an evaluation of signal variations due to multiple-pass phenomena. A B K

A71-36513 Synchronizations of a time multiplex for air traffic control (Les synchronisations d'un multiplex temporel pour la gestion du trafic aérien). G. David and M. Duquenne (Télécom-

munications Radioélectriques et Téléphoniques, Le Plessis-Robinson, Hauts-de-Seine, France). In Space and communication. Acquisition and transmission of data in space applications systems, Union des Associations Techniques Internationales and Société Française des Electroniciens et des Radioélectriciens, International Conference, Paris, France, March 29-April 2, 1971, Communications. Volume 1 (L'espace et la communication Collecte et transmission de l'information dans les systèmes spatiaux d'application, Union des Associations Techniques Internationales and Société Française des Electroniciens et des Radioélectriciens, Colloque International, Paris, France, March 29-April 2, 1971, Communications Volume 1) Colloquium co-sponsored by the Fédération Nationale des Industries Electroniques and the Centre National d'Etudes Spatiales Paris, Comité d'Organisation du Colloque de Paris, 1971, p. 196-205. In French

Description of the primary synchronization and the scanning field reconnaissance in the onboard equipment of the Dioscures system The use of these two synchronizations for the realization of the telemetry function is demonstrated The problem of optimal detection of data received in the base band, involving the reconstruction of the primary clock (frequency of 90 kHz), is considered, as well as the problem of bit recognition by means of a pseudorandom code - the scanning field code. A.B.K

A71-36514 A meter wave aircraft antenna for communication between Concorde and a satellite (Antenne en ondes métriques pour avion destinée à la liaison entre Concorde et un satellite) C Ancona and J Choquer (Société Technique d'Application et de Recherche Electronique, Massy-Palaiseau, Essonne, France) In Space and communication Acquisition and transmission of data in space applications systems, Union des Associations Techniques Internationales and Société Française des Electroniciens et des Radioélectriciens, International Conference, Paris, France, March 29-April 2, 1971, Communications Volume 1 (L'espace et la communication Collecte et transmission de l'information dans les systèmes spatiaux d'application, Union des Associations Techniques Internationales and Société Française des Electroniciens et des Radioélectriciens, Colloque International, Paris, France, March 29-April 2, 1971, Communications Volume 1). Colloquium co-sponsored by the Fédération Nationale des Industries Electroniques and the Centre National d'Etudes Spatiales Paris, Comité d'Organisation du Colloque de Paris, 1971, p. 216-225 In French

Consideration of the problem of designing a meter wave antenna to serve as an air-to-ground link from the Concorde to ground stations via satellite After a brief formulation of the problem, the reasons for adopting a port-starboard radiation mode switching are outlined It is recommended that an H-shaped slot antenna be used (instead of a classical half-wave antenna) which is the equivalent of a dipole with a capacitive roof Synthetic radiation patterns of the proposed antenna are presented The operation of the antenna is discussed, and its probable efficiency is determined. A B K

A71-36553 Utilization of frequency memorization in space radiocommunication (Utilisation de la mémorisation de fréquence en radiocommunications spatiales). A Olveti (Ing. C Olivetti e C. S.p.A., Ivrea, Italy) In Space and communication Acquisition and transmission of data in space applications systems, Union des Associations Techniques Internationales and Société Française des Electroniciens et des Radioélectriciens, International Conference, Paris, France, March 29-April 2, 1971, Communications Volume 2 (L'espace et la communication Collecte et transmission de l'information dans les systèmes spatiaux d'application, Union des Associations Techniques Internationales and Société Française des Electroniciens et des Radioélectriciens, Colloque International, Paris, France, March 29-April 2, 1971, Communications Volume 2). Colloquium co-sponsored by the Fédération

Nationale des Industries Electroniques and the Centre National d'Etudes Spatiales Paris, Comité d'Organisation du Colloque de Paris, 1971, p. 716-725. 7 refs In French.

Brief survey of the different classes of frequency memorization apparatus, followed by examination of the application of frequency memories to earth-satellite-aircraft uhf communications Attention is also given to repeater apparatus and to multiple-access transmission of half-tone images in a worldwide satellite communication system F.R.L.

A71-36605 High aperture, wide angle lenses for compact electro-optical systems. P J Rogers (Pilkington Perkin-Elmer, Ltd., St Asaph, Wales) In Electro-optics '71, Industrial and Scientific Conference Management, International Conference, Brighton, England, March 23-25, 1971, Proceedings Conference co-sponsored by the British Scientific Instrument Research Association Chicago, Industrial and Scientific Conference Management, Inc., 1971, p. 44-57

The optics of some airborne navigational instruments are described, with emphasis on the design of the high aperture, wide angle lenses required for these devices Most of the instruments considered are of the moving map projection type mounted in the aircraft instrument panel and thus used in a head down rather than head up mode by the pilot Additionally, some special features of an optical system for accurate projection of a marker representing aircraft position and direction onto a standard navigator's paper map are outlined T.M.

A71-36613 A system for recording the path of high speed moving objects. N P Barton (Military Vehicles and Engineering Establishment, Chertsey, Surrey, England) In Electro-optics '71, Industrial and Scientific Conference Management, International Conference, Brighton, England, March 23-25, 1971, Proceedings Conference co-sponsored by the British Scientific Instrument Research Association Chicago, Industrial and Scientific Conference Management, Inc., 1971, p. 336-343

Description of a practical and cost-effective trajectory plotting system for gunnery range instrumentation The system, which is accurate, easy to operate and maintain, and allows a simple analysis of recorded data, uses three measurements to define a single point or the trajectory relative to a straight line between the gun and the target, these are range and two coordinate measurements The system is designed to acquire this information and also to give velocity information For some projectiles, velocities can approach 1500 msec The principle of this projectile plotting system can be applied to recording the path of an aircraft coming in to land under the control of automatic landing equipment M.M

A71-36658 Aircraft jet engine application of E.D.M. for repetitive continuous production. C J Foster (General Electric Co., New York, N.Y.) Society of Manufacturing Engineers, International Engineering Conference and Tool Exposition, Philadelphia, Pa., Apr 26-30, 1971, Paper MR 71-143. 18 p Members, \$1 50, nonmembers, \$2 00

The majority of the Electric Discharge Machining (E.D.M.) applications involve small wires for air cooling holes, special slotting for expansion joints that produce final assembly dimensions of finished assemblies, and contours for through and blind pocket configurations Automatic and modified standard E.D.M. production applications are evaluated in detail It is found that the best results are obtained from automated closed cycle equipment by controlling the parameters of the E.D.M. process Various factors which must be considered for every repetitive operation are listed together with the production aids to be used. G R

A71-36661 The odyssey of diffusion bonding. H A Johnson and G W. Trickett (USAF, Materials Laboratory, Wright-Patterson AFB, Ohio). *Society of Manufacturing Engineers, International Engineering Conference and Tool Exposition, Philadelphia, Pa., Apr 26-30, 1971, Paper AD 71-245*. 9 p. 6 refs. Members, \$1 50, nonmembers, \$2.00

The Air Force is continually looking for new or improved processes that can make aerospace configurations more economically and that can make them more reliable and with higher mechanical properties. Diffusion bonding is one of these processes. All of the problems have not been solved and even when they are, the process will not be a manufacturer's panacea. However, diffusion bonding will have many applications in the manufacture of aerospace parts, particularly those made of titanium. Recognizing this potential the Air Force has spent considerable time and money to help make diffusion bonding a usable manufacturing method. (Author)

A71-36671 Some air transportation concepts for the future. R. H. Miller (MIT, Cambridge, Mass.) *Aeronautical Journal*, vol 75, July 1971, p 431-456. 37 refs. Research supported by the US Department of Transportation

The growth of air travel for three typical travel markets during the last two decades is examined. It is pointed out that a large mass market exists for general short-haul travel. The potential of service by air not only for airport access but for all travel in the zone served by the long and medium-haul air terminal is examined. A quantitative assessment of the total transport concept is attempted, analyzing the market to be served, the economic factors which will eventually determine the viability of an air system, the environmental factors of noise and pollution, and the important factors of safety, convenience, and dispatch reliability. New vehicle concepts evolve from such a systems study for both short- and long-haul travel. The potential gains in travel time from any point to another on the globe are examined. G.R.

A71-36672. The development of the BAC One-Eleven autopilot. L. J. Roberts (British Aircraft Corp., Ltd., Wisley, Surrey, England) *Aeronautical Journal*, vol 75, July 1971, p 457-462; Discussion, p. 463, 464.

The aircraft as an autopilot problem is considered, and questions of the choice of autopilot are examined, taking into account the PB 20 and the 2000 series autopilot. The G-ASYD Cat 2 program is discussed, together with the 2100 and 2200 series (Cat 2) autopilots. Various difficulties during the development work are reported. Initial failures were followed by a great instrumentation breakthrough during the latter part of 1969. Co-Co, a unique Computer Compatible system, became operational. This system involves a digital representation of the airborne flight test data, produced on tape which can then be transferred directly to ground computers. After changes to the azimuth the autopilot was flown in 1970 and performed very well. G R

A71-36673 BCAR A8 - Problems and benefits. W Hampton (Hawker Siddeley Aviation, Ltd., Hatfield, Herts., England) *Aeronautical Journal*, vol 75, July 1971, p 465-470

The philosophy evolved for ensuring high standards and quality levels in the design, development, production, inspection, and product support of a civil aircraft is discussed. Quality responsibilities and control systems of all sections were collected and written down in a single production and quality manual. This made it possible to reveal areas where minor changes were necessary to ensure proper operation of quality control and coordination of all quality functions. V P

A71-36675 The random heave-pitch response of aircraft to runway roughness. C L Kirk (Cranfield Institute of Technology, Cranfield, Beds., England) *Aeronautical Journal*, vol 75, July 1971, p 476-483.

The problem of predicting the response of aircraft during taxiing on rough runways and the associated dynamic loads and fatigue damage is examined. An analysis by Kirk and Perry (1971) of the random response of a flexible aircraft to forces transmitted through the main undercarriage is extended to a rigid aircraft, with allowance for nonlinearities in damping in the main and nose undercarriage. It is shown how this response can be computed with the aid of power spectral techniques. V P.

A71-36676 The civil aircraft market - An examination of the replacement order cycle and the used aircraft market. A. P. Ellison (Queen Mary College, London, England) *Aeronautical Journal*, vol 75, July 1971, p 493-504.

The relationship between the age of aircraft, scrapping, and reordering is studied on the basis of a detailed analysis of aircraft histories, the date and age of aircraft scrapping, crashes, and reordering. The analysis also provides information on aircraft sales and their relationship to aircraft deliveries. An estimatable model of used aircraft prices is constructed and is applied to the collected data. The effects of technological changes on airline profits (in the form of the replacement of propeller aircraft by jets) and the ability of airlines to adjust their depreciation policies in order to account for these changes are examined. V P.

A71-36677 Studies of the lift problem for slender wings in supersonic flows (Untersuchungen über das Auftriebsproblem schlanker Tragflügel bei Überschallströmung). Arabindo Das and Hans-Holger Schroeder (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Aerodynamik, Braunschweig, West Germany) *Zeitschrift für Flugwissenschaften*, vol 19, July 1971, p 265-281. 46 refs. In German

Comparison of the results of the exact linearized theory, the extended slender body theory, and the theory of very slender bodies with each other and with measurement results. Of particular interest is the nature of the transition from subsonic to supersonic leading edges, the magnitude of the suction force on the leading edge, the influence of viscosity on the flow past a wing, and nonlinear effects due to increasing Mach number and increasing angle of attack. A detailed study was made of these factors for eight wings with various slenderness ratios and planforms. The investigations were carried out in a large supersonic wind tunnel in the Mach number range from 1.5 to 4.0. The Reynolds number based on the maximum wing chord was held constant for each wing model at values between 1.4×10^6 to the 7th and 2.4×10^6 to the 7th power. A.B.K.

A71-36680 Potentiometric determination of acid numbers in aircraft turbine oils (Über die potentiometrische Bestimmung der Säurezahlen von Flugturbinenölen). Eilhard Jantzen (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Flugtrieb- und Schmierstoffe, Munich, West Germany) *Erdöl und Kohle Erdgas Petrochemie vereinigt mit Brennstoff-Chemie*, vol. 24, 1971, p. 220-226. 17 refs. In German.

An automatic titration apparatus was used for determining the pH values of turbine oils. The preliminary tests with pure substances showed the influence of solvents and their mixtures on the titration curve and inflection point. Tetrabutyl ammonium hydroxide was used as a titrating agent. Optimum results were obtained with chlorobenzene/dimethylsulfoxide and toluene/dimethylsulfoxide at the ratio 3:1. The relationship between the acid number and the size of sample was studied for various aircraft oils. Good repeatability and satisfactory accuracy of results were obtained. Z W

A71-36725 # Influence of semifinished products production technology on the mechanical properties of heat-resistant alloys (Vliianie tekhnologii proizvodstva polufabrikatov na mekhanicheskie svoystva zharosprochnykh splavov). A. F. Belov, N. D. Bobovnikov, and O. Kh. Fatkullin (VILS, Moscow, USSR) *Problemy Prochnosti*, vol. 3, June 1971, p. 105-109. In Russian.

Improvements in the technological processes of preparing nickel- and tungsten-base jet-engine alloys achieved during the past few years are examined. Particular attention is given to such factors as isothermic closed-die forging of blades and disks, investment casting, combined closed-die forging and rolling of blades, new melting processes, and the use of powder metallurgy, diffusion welding, and so forth. The advantages which accrue from electric arc vacuum melting and improvements in electrode technology are noted. A comparison of aircraft-engine heat-resistant alloy specifications over the last 15 years is given in tabular form. V.P.

A71-36752 Some new results of flight dynamics. I (Quelques résultats nouveaux de la mécanique du vol I) Werner Schulz (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Porz-Wahn, West Germany) and Peter Hamel (Hamburger Flugzeugbau GmbH, Hamburg, West Germany) (*Association Française des Ingénieurs et Techniciens de l'Aéronautique et de l'Espace et Deutsche Gesellschaft für Luft- und Raumfahrt, Journée Otto Lilienthal, 11th, Paris, France, Dec 16, 1970.*) *L'Aéronautique et l'Astronautique*, no. 29, 1971, p. 5-16. 34 refs. In French.

After appreciating the methodical change of theoretical considerations and experimental investigations, with which Otto Lilienthal tried to approach the solution of the problem of the free flight of man, three topics are discussed, to the treatment of which flight dynamics can be useful: the problem of flight noise, the decrease of the influence of gusts on aircraft, and the problem of dynamic stability of parachute-load systems. A reduction of noise annoyance on the ground, particularly after the take-off of V/STOL aircraft, may be obtained by the determination of noise optimal flight profiles. For gust decrease, the method of 'tuned lift control', the lift due to automatic control attacking in the neutral point of the aircraft, proves to be the most advantageous. The analytical treatment of the greatly nonlinear problem of dynamic stability of parachute-load systems succeeds well by employing the theory of describing function, as comparison with results obtained by numerical integration shows. (Author)

A71-36754 Experimental study of the near wake of a slender cone at angle of attack and at freestream Mach number of 7 (Étude expérimentale du sillage proche d'un cône élancé en incidence à freestream Mach number equals 7). Jacques Marcillat (Aix-Marseille, Université, Marseille, Centre de Documentation de l'Armement, Paris, France) *L'Aéronautique et l'Astronautique*, no. 29, 1971, p. 49-58. 24 refs. In French. Research supported by the Office National d'Études et de Recherches Aéropatiales.

Wind tunnel study of the streamline configuration of the near wake in the symmetry plane of a cone of revolution of non-zero angle of attack in supersonic flow at a freestream Mach number of 7. Experimental distribution determinations of static pressure, stagnation temperature, and stagnation pressure made it possible to establish with accuracy and completeness the configuration of the near wake of a 9-deg cone set at angles of attack ranging from 0.5 to 15 deg, for a freestream Reynolds number of 110,000 per cm. Through integration of the mass flow rate, it has been possible to obtain the streamline pattern in the symmetry plane. M.V.E.

A71-36756 Wakes of inclined wedges in rarefied hypersonic flows (Sillages de dièdres en écoulements hypersoniques raréfiés). J. Allegre (Société d'Études de Constructions de Souf-

fleries, Simulateurs et Instrumentation Aérodynamique, Paris, France) and C. Matrand (CNRS, Laboratoire d'Aérodynamique, Meudon, Hauts-de-Seine, France). (*Symposium International de la Dynamique des Gaz Raréfiés, 7th, Pisa, Italy, June 29-July 3, 1970.*) *L'Aéronautique et l'Astronautique*, no. 29, 1971, p. 73-80. 8 refs. In French. Research supported by the Direction des Recherches et Moyens d'Essais.

Experiments give qualitative and quantitative results concerning the base flow and the wake of wedges located with incidence in rarefied hypersonic flows. Mach number values are 4, 8 and 20 corresponding to free stream Reynolds numbers between 320 and 2200 per cm, flow conditions are simulating flights of rockets in rarefied atmosphere at altitudes more than 50 km. Pressure and density measurements allow the determination of rarefaction and incidence effects on the geometrical and aerodynamic characteristics of the wake flow pattern. (Author)

A71-36757 The strategic bomber North American Rockwell B-1A (Le bombardier stratégique North American Rockwell B-1A). Georges Bruner (Centre de Documentation de l'Armement, Paris, France) *L'Aéronautique et l'Astronautique*, no. 29, 1971, p. 81-86. In French.

The specifications of the AMSA program aimed at the equipment - from 1978 - of the US Air Force with a new strategic bomber capable of penetrating into the defenses of any potential enemy having been recalled, the reasons which have motivated the choice of North American Rockwell for the airframe and of General Electric for the engine building are indicated. A brief description of the aircraft submitted by NAR - the B-1 - is given together with some details on its characteristics, performance, electronic equipment, armament and on the program progression. (Author)

A71-36809 # Numerical solution of the equations of motion of an aircraft turbine engine (Technické novinky a zajímavosti v letectví). Jiří Kučera *Zpravodaj VZLÚ*, vol. 2, no. 86, 1971, p. 19-32. In Czech.

Discussion of the use of computers when solving equations of motion of gas turbine engines by means of different numerical methods. Solutions are given for the equations of motion of single- and dual-shaft engines. The operational characteristics of the engine are analyzed, and the corresponding differential equations are used as a basis for choosing the suitable numerical method. One-step and four-step methods considered include Euler's method, the fourth-order Runge-Kutta method, the fifth-order Runge-Kutta method (Merson's modification), the Adams method, the Bashforth method, and an implicit method. The optimization of step length is based on a criterion for minimum deviation from an assessed exact solution. T.M.

A71-36810 # Processing of information concerning license norms on the Minsk 22 computer by the MINSK-ARDIS system (Zpracování informací o licenčních normách na samočinném počítači Minsk 22 systémem MINSK-ARDIS). Hynek Císar *Zpravodaj VZLÚ*, vol. 2, no. 86, 1971, p. 33-46. In Czech.

Description of indexing procedures, storage techniques, and data recovery operations in a central computerized system of collecting information about license norms and standards in the aircraft industry. The system is based on the Minsk 22 computer with the MINSK-ARDIS program. Information provided by the system includes the date when a particular specification standard was issued, its contents, storage designation, reference to other relevant standards, differences with superseded standards, and differences with comparable foreign standards. T.M.

A71-36918 The new IATA conditions of carriage for passengers and baggage (Die neuen IATA-Beförderungsbedingungen für Fluggäste und Gepäcke). Alfred Rudolf *Zeitschrift für Luftrecht*

und Weltraumrechtsfragen, vol 20, July 1, 1971, p. 153-165, 233-254. 63 refs. In German

General conditions of carriage in international air traffic were specified in a conference of the International Air Transport Association (IATA) in Honolulu in 1970. These conditions of carriage were to become effective as Recommended Practice 1013 on Apr 1, 1971. A number of legal relationships between passenger and carrier are discussed, giving attention to differences between the new regulations and the previous versions. Similar recommendations had been developed for the first time within the framework of the International Air Traffic Association in 1927. The further history of these international regulations is examined. Questions of applicability are considered together with problems involving charter regulations. Other legal questions discussed are related to tickets, fare, meals, and liability. G.R

A71-36919 The new Finnish air traffic law (Das neue finnische Luftfahrtgesetz). Tenho Autere. *Zeitschrift für Luftrecht und Weltraumrechtsfragen*, vol. 20, July 1, 1971, p. 166-170. In German

The new Finnish law of 1964 is the result of a long cooperation between Finland, Sweden, Norway, and Denmark. The law is based on the agreements reached in Chicago regarding the international civil aviation. An aircraft in the Finnish air space is subject to the Finnish law and to the regulations based on it. Regulations discussed are related to the operational state of the aircraft, qualifications and authority of aircraft personnel, construction and operation of airports, and the occurrence of special incidents. G.R

A71-36920 The Warsaw Convention as amended at The Hague, 1955 and at Guatemala, 1971 (Das Warschauer Abkommen in der Fassung von Den Haag 1955 und Guatemala 1971). *Zeitschrift für Luftrecht und Weltraumrechtsfragen*, vol. 20, July 1, 1971, p. 176-189. In German

The Warsaw Convention as amended at The Hague in 1955 has been changed at a international conference at Guatemala in accordance with the Protocol of Mar. 8, 1971. The regulations in their new form are presented. There are five chapters dealing with the subject of the convention, documents such as the ticket and papers for the baggage, liability, and general regulations. Regulations concerning cases in which other means of transportation are used in addition to aircraft are also provided. G.R

A71-36921 Law for protection against aircraft noise of March 30, 1971 (Gesetz zum Schutz gegen Fluglärm Vom 30. März 1971). *Zeitschrift für Luftrecht und Weltraumrechtsfragen*, vol. 20, July 1, 1971, p. 189-196. In German.

The regulations of the law presented are contained in two sections. The first section is concerned with the objective and the applicability of the law, the area which is to be protected, financial questions concerning protective measures in the construction of houses, and obligations of airport authorities to provide information to the government. The second section discusses changes in the air traffic law. G.R

A71-36922 Reduction of stratospheric ozone by nitrogen oxide catalysts from supersonic transport exhaust. Harold Johnston (California, University, Berkeley, Calif.). *Science*, vol. 173, Aug 6, 1971, p. 517-522. 37 refs. AEC-supported research.

Although a great deal of attention has been given to the role of water vapor from supersonic transport (SST) exhaust in the stratosphere, oxides of nitrogen from SST exhaust pose a much greater threat to the ozone shield than does an increase in water. The

projected increase in stratospheric oxides of nitrogen could reduce the ozone shield by about a factor of 2, thus permitting the harsh radiation below 300 nanometers to permeate the lower atmosphere. (Author)

A71-36934 # Helicopter noise due to blade-vortex interaction. Sheila Widnall (MIT, Cambridge, Mass.). *Acoustical Society of America, Journal*, vol. 50, July 1971, pt 2, p. 354-365. 13 refs. Contract No. DA-31-124-ARO(D)-471

The generation of impulsive sound, commonly called blade slap, due to blade-vortex interaction for helicopter rotors is discussed. The unsteady lift on the blades is calculated using linear unsteady aerodynamic theory for an oblique gust model of the blade-vortex interaction. A theoretical model for the radiated sound due to the transient lift fluctuations is presented. Expressions for the directivity, frequency spectrum, transient signal, and total power of the acoustic signal are derived. Typical results are presented and discussed. Calculations of the transient signal are presented in comparison with recent experimental results. The agreement is very good. (Author)

A71-36962 # Terms of commercial air traffic (Begriffe des kommerziellen Luftverkehrs). Hans Arndt, Gunter Cortes, Ernst Dittmann, and Christian Kunack. *Technisch-ökonomische Informationen der zivilen Luftfahrt*, vol. 7, no. 5-6, 1971, p. 229-280. In German

The glossary presented provides definitions of the most common terms of commercial air traffic taking into consideration words in German as used in the German Democratic Republic and expressions of international usage in English. The English equivalent term is frequently supplied together with a German expression listed. A list of commonly used abbreviations of German terms is also provided. G.R

A71-36970 # The Link 747 simulator. Ed Mack Miller (United Air Lines, Inc., Chicago, Ill.). *Tech Air*, vol. 27, Aug 1971, p. 4-6

Description of the highly sophisticated 747 simulator which incorporates a six-degree-of-motion system to provide a high degree of realism. A major component is the Malfunction Insertion and Display Unit (MIDU), a large screen on which 48 slides can be projected. MIDU makes it possible simultaneously to train engineers and pilots, using different sets of data. The simulator can be 'initialized' to any of hundreds of possible places, in flight or on the ground. The Variable Anamorphic Motion Picture (VAMP) system, soon to be installed, is described. F.R.L

A71-36971 # BOAC's 747 flight simulator. D Everest (British Overseas Airways Corp., London Airport, Hounslow, Middx., England). *Tech Air*, vol. 27, Aug 1971, p. 6-8

Description of the BOAC digital computer type simulator, the computer system of which has a capacity of 56 K words with 16 bits to a word. Four degrees of movement are provided. Full simulation of all systems is obtained with the exception of an actual picture on the weather radar screens. The simulator is used for pilot and flight engineer conversion training, pilot and flight engineer check flights, and training of maintenance engineers in system checks and engine ground running procedures. F.R.L

A71-36993 Computer-based twin-radar air traffic control system (Eine Anlage zur rechnergestützten Luftraumbeobachtung mit Hilfe von zwei Radargeräten). Eberhard Hanle (Forschungs-

institut für Funk und Mathematik, Werthhoven, West Germany)
Nachrichtentechnische Zeitschrift, vol 24, July 1971, p 375-380 10
refs. In German

An experimental study of computer-based multiradar aircraft tracking is conducted with the aid of a twin radar air traffic control system in operation. Its crucial components are described: digital plot extractors for primary radar responses using sliding-window-detectors, and transmitters feeding the radar data to a computer. The overall operation of the system is discussed.

M.V E

A71-37056 **Testing aircraft parts by NDT methods.**
Kingston G Wolf (U.S. Navy, Metals Div., Jacksonville, Fla.) *Metal Progress*, vol 100, Aug 1971, p 57, 58

The installations described include an ultrasonic system for finding defects in valves and a fluorescent particle system for detecting cracks in a variety of aircraft parts. The first installation consists of an ultrasonic pulse unit, plus a special fixture and transducer assembly. The transducer is sensitive enough to find breaks as small as 0.005 in. wide, 0.006 in. deep, and 3/8 in. long. A valve is inspected in less than a minute. The fluorescent particle system consists of a series of processing stations connected by a heavy-duty roller conveyor. Items tested for surface defects include all nonferrous engine cases, landing gears, and ground-handling equipment.

Z W

STAR ENTRIES

N71-29215# Tyco Labs., Inc., Pomona, Calif General Nucleonics Div

FEASIBILITY STUDY OF DESIGN AND FABRICATION OF NUCLEAR HELICOPTER LIFT INDICATOR (NUHELI) Final Report, Jul. 1968 - Jul. 1970

Donald W Blincow Feb 1971 138 p refs

(Contract AT(04-3)-805)

(SAN-805-1) Avail NTIS

The development of a nucleonic instrumentation system for continuous on-board indication of helicopter lift capability and the testing of a prototype system in a realistic environment are described. The system uses X-ray backscatter from a Kr-85 source and a temperature sensor to measure ambient air density and temperature outside the vehicle and computes gross lift capability in an all-digital computer. Combining the lift capability output with helicopter start gross weight and present fuel quantity provides the pilot with a real-time readout of his lift margin at maximum rotor speed before he commits the vehicle to take off or other critical maneuver

Author (NSA)

N71-29221*# Lockheed Missiles and Space Co., Sunnyvale, Calif
UNSTEADY AIRFOIL STALL AND STALL FLUTTER

Lars E Ericsson and J. Peter Reding Jun 1971 135 p refs

(Contract NAS1-9987)

(NASA-CR-111906, LMSC-A-6J-71-1) Avail NTIS CSCL01A

The unsteady airfoil stall characteristics are described analytically using static experimental data as an input. It is found that the dynamic overshoot of static stall does not in itself generate any time lag above the Karman-Sears wake lag. It is the post stall aerodynamic forces that create an additional time lag, which is dominant at high frequencies. The analytic theory is found to predict dynamic loops and measured negative damping as long as the frequency is not very large. In the latter case, a graphical method for modulation of the separation induced phase lag gives improved agreement with experimental data. The effects of compressibility and shock-induced boundary layer separation are included in the analysis, and it is shown that the experimentally determined stall flutter boundaries of a space shuttle wing can be predicted using only static data as an input

Author

N71-29256# Civil Aeronautics Board, Washington, D C
REMARKS PREPARED FOR DELIVERY BY THE HONORABLE SECOR D. BROWNE, CHAIRMAN, CIVIL AERONAUTICS BOARD, BEFORE THE AVIATION DAY LUNCHEON, SEATTLE CHAMBER OF COMMERCE

Secor D Browne Oct 1970 13 p Luncheon held in Seattle, 29 Oct 1970

Avail Issuing Activity

Air carriers' problems and areas where the Civil Aeronautics Board and the carriers can take corrective steps are discussed. Capacity, fare increases, the expense which would result from retrofitting if required for protecting the environment, the necessity to improve controls for preventing hijacking, and uncoordinated

access transportation are considered, and areas in which the carriers might cut costs are indicated. The problems of local airline service and subsidy, and of supplemental air carriers are described. The impact of the carriers' financial health on the aircraft industry and the need to have a strong R and D program for advanced aircraft such as the SST and short-haul aircraft are also covered

N E N

N71-29285# Southampton Univ (England) Transportation Research Group

INTER-CITY VTOL STUDIES (UK) BUSINESS TRAFFIC AND POTENTIAL SITES. VOLUME 1: BUSINESS TRAFFIC Final Report

Aug 1969 158 p ref

(Contract PD/40/052)

(AE-326/021-Vol-1) Avail NTIS

The surveys and analyses which were made of business travel from establishments in eight urban areas in the United Kingdom are presented. The studies were undertaken to determine the economic feasibility of establishing a vertical takeoff and landing airline operation. The basic trip characteristics of business travelers and the relationships of trip generation and distribution are discussed

Author

N71-29286# Southampton Univ (England) Transportation Research Group

INTER-CITY VTOL STUDIES (UK) BUSINESS TRAFFIC AND POTENTIAL SITES. VOLUME 2: POTENTIAL SITES Final Report

Aug 1969 247 p ref

(Contract PD/40/052)

(AE-326/021-Vol-2) Avail NTIS

Feasibility studies and analyses associated with potential sites for VTOL terminals in eight selected urban areas within the United Kingdom are presented. Analyses were made of the proposed land use patterns, population, employment, communications, and traffic to identify a number of possible VTOL sites. It is concluded that a number of potential sites for VTOL terminals are available and that VTOL commercial air transportation is feasible

Author

N71-29305# National Aviation Facilities Experimental Center, Atlantic City, N J

PREVENTION OF AIRCRAFT LOSS OF CONTROL USING A SIMPLE HEAD-UP DISPLAY Final Report, Jul 1969 - Dec. 1970

Gerald E Skelton and Richard L Sulzer Jun 1971 24 p

(FAA-NA-71-9, FAA-RD-71-28) Avail NTIS

To evaluate the concept of a simple head-up display (HUD) as an aid to noninstrument-rated pilots encountering reduced flight visibility conditions, two versions of such a display were flown by six pilots. The subject pilots were pretested to insure that they could not perform standard maneuvers when outside visual reference and panel attitude instruments were obscured leaving only the altimeter, airspeed indicator, gyroscopic direction indicator, gyroscopic rate-of-turn/slip-skid indicator and clock. Given either of the HUD instruments and a partial panel of basic instruments, plus a brief indoctrination in the use of the HUD, the pilots showed marked improvement in preservation of aircraft control. The opinions of expert observers suggest that, with a few hours of additional training, inexperienced pilots would be able to employ a simple HUD with a further improvement of aircraft safety when penetrating adverse weather

Author

N71-29306# National Aviation Facilities Experimental Center, Atlantic City, N J

SIMULATION STUDY OF CHEVRON MARKINGS FOR AREAS ADJACENT TO RUNWAY THRESHOLDS Interim Report, Dec. 1970-Mar. 1971

Guy S Brown and Richard L Sulzer Jul 1971 20 p refs (FAA-NA-71-27, FAA-RD-71-40) Avail NTIS

To determine the minimum system of chevron markings that would give warning to potentially deceptive, nonload-bearing paved areas before a runway threshold, 20 pilots were given systematic exposure in a flight simulator to narrowed and more widely spaced chevron patterns, and also to the present U S Standard The judgments made by these pilots were that both the conventional pattern of full-width chevrons spaced 100 feet apart and a pattern of standard-width chevrons spaced 200 feet apart provided distinct and unambiguous warning of the nonload-bearing surface. Further, they reported that these two patterns were not confusable with other markings such as the runway threshold stripes. Pilot judgments of the two patterns with narrowed chevrons were mixed. While a majority reported the narrowed chevrons not confusable, there was a marked increase in the number reporting absence of distinct and unambiguous guidance, particularly when the markings were viewed from a position low on glide slope and offset from the centerline

Author

N71-29307# IIT Research Inst., Chicago, Ill

STUDY OF VISIBLE EXHAUST SMOKE FROM AIRCRAFT JET ENGINES Final Report

John Stockham and Howard Betz Jun 1971 75 p refs (Contract DOT-FA69WA-2208)

(FAA-NA-71-24, FAA-RD-71-22) Avail NTIS

The visibility of inflight jet exhaust is compared to the SAE smoke number. A method based on photographic photometry was developed for measuring the optical density of smoke plumes. This method was related to visibility and to the smoke number through transmissometer measurements and visibility theory. A portable transmissometer, capable of operating over a wide range of optical path lengths and under varying ambient light conditions was fabricated for use on this study. The mathematical expression relating the transmission measurements to the smoke number was derived. Luminous visibility requirements of smoke trails, developed from light scattering theory, correlated with actual visual observations and the transmissometer and photometry measurements

Author

N71-29309# Little (Arthur D.), Inc., Cambridge, Mass

AN APPROACH TO THE ESTABLISHMENT OF PRACTICAL AIR TRAFFIC CONTROL SAFETY GOALS Interim Report

S F Lister and G Raisbeck May 1971 60 p refs

(Contract DOT-FA70WA-2141)

(FAA-RD-71-36) Avail NTIS

This report shows how a knowledge of the incidence of fatal aircraft accidents in the recent past can be combined with an estimate of the overall risk in various types of human activity, which have been found socially acceptable, to produce rational, quantitative goals for the risk associated with air traffic control. Fatal accidents over an eight-year period, from 1961 to 1968 inclusive, are categorized in 36 groups based on 6 phases of flight and 6 type-cause categories. The improvement in overall air transportation safety which could be achieved by reducing or eliminating all sources of accident which are, in any way, related to air traffic control is examined. Inasmuch as the majority of fatalities cannot, by the most generous reckoning, be associated with air traffic control, the total possible improvement is not impressive. When, on the other hand, proportional reduction in risk from all causes is assumed, a set of mutually compatible risk goals for each of the 36 groups can be stated

Author

N71-29333# Advisory Group for Aerospace Research and Development, Paris (France)

SYMPOSIUM ON UNSTEADY AERODYNAMICS FOR AEROELASTIC ANALYSES OF INTERFERING SURFACES, PART 1

April 1971 92 p refs Held at Tonsberg, Norway, 3-4 Nov 1970

(AGARD-CP-80-71) Avail NTIS

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3 REPRESENTATION OF A WING IN THE LIFTING LINE, APPLICATION OF THE INTERACTION CALCULATIONS OF TWO WINGS IN TANDEM R Dat and Y Akamatsu (Office Natl D'Etudes et de Recherches Aeronautiques, Paris, France) 17 p refs

4 A SUPERSONIC BOX COLLOCATION METHOD FOR THE CALCULATION OF UNSTEADY AIRFORCES OF TANDEM SURFACES D L Woodcock and E J York (Royal Aircraft Estab., Farnborough, England) 26 p refs

N71-29334# Stanford Univ., Calif

SOME CONSIDERATIONS RELATIVE TO THE PREDICTION OF UNSTEADY AIR LOADS ON INTERFERING SURFACES

H Ashley In AGARD Symp on Unsteady Aerodynamics for Aeroelastic Analyses of Interfering Surfaces, Part 1 Apr 1971 22 p refs

Avail NTIS

Loading singularities inherent in linearized potential theory are classified as local, in the sense that both the nature and magnitude of the singularity are determined by boundary conditions in the inner field, or global, in the sense that the entire boundary value problem must be solved to determine their details. Available results are reviewed relative to discontinuities in surface slope, planform shape, dihedral angle, etc., and suggestions are offered for combining them into numerical solution schemes. With respect to the analysis of interfering lifting surfaces, selected recent activity in the United States on continuous solution of various subsonic and supersonic cases is described. Regarding the area-element or box approach to the latter, it is recommended that an element in the form of a trapezium, similar to that employed by Woodward for steady flow, will also improve the behavior of predicted loads for oscillatory motion of interacting surfaces. Formulas for certain of the required influence coefficients are developed. Some nonlinear effects are examined which are felt to have greater significance for interference problems than for isolated lifting wings. The phenomena include the normal displacement and self-deformation of wakes which induce loads on aft surfaces, the local influences of profile thickness, and displacement due to boundary layer growth

Author

N71-29335# Royal Aircraft Establishment, Farnborough (England) **CALCULATION METHODS FOR UNSTEADY AIRFORCES OF TANDEM SURFACES AND T-TAILS IN SUBSONIC FLOW**

D E Davis In AGARD Symp on Unsteady Aerodynamics for Aeroelastic Analyses of Interfering Surfaces, Part 1 Apr 1971 22 p refs

Avail NTIS

The basis of numerical methods, using continuous distributions of loading, for evaluating oscillatory generalised airforce coefficients

for interfering and intersecting surfaces inclined everywhere at small angles to a subsonic mainstream flow is described. Particular application to tandem surfaces and T-tails is discussed briefly.
Author

N71-29336# Office National d'Etudes et de Recherches Aérospatiales, Paris (France)

REPRESENTATION OF A WING IN THE LIFTING LINE; APPLICATION OF THE INTERACTION CALCULATIONS OF TWO WINGS IN TANDEM [REPRESENTATION D'UNE AILE PAR DES LIGNES PORTANTES; APPLICATION AU CALCUL DE L'INTERACTION DE DEUX AILES EN TANDEM]

R. Dat and Y. Akamatsu. In AGARD Symp on Unsteady Aerodynamics for Aeroelastic Analyses of Interfering Surfaces, Part 1. Apr 1971. 17 p. refs. In FRENCH, ENGLISH summary

Avail NTIS

The simulation of wings by a lattice of lifting lines is summarized for the computation of unsteady aerodynamic forces on combinations including several lifting surfaces, such as wing-horizontal tail or fin-horizontal tail. It can be considered as a compromise between the doublet lattice method which is advantageous for its flexibility, and the so called lifting surface method whose results are more accurate for a given number of collocation points. A numerical program was developed for the application to wings lying in two parallel planes. The particular features of the method of calculation are presented, as well as some numerical results.
Author

N71-29337# Royal Aircraft Establishment, Farnborough (England)
A SUPERSONIC BOX COLLOCATION METHOD FOR THE CALCULATION OF UNSTEADY AIRFORCES OF TANDEM SURFACES

D. L. Woodcock and E. J. York. In AGARD Symp on Unsteady Aerodynamics for Aeroelastic Analyses of Interfering Surfaces, Part 1. Apr 1971. 26 p. refs.

Avail NTIS

A box collocation method is developed for the determination of the airforces on a pair of tandem surfaces (not necessarily coplanar) undergoing small oscillatory displacements in a supersonic flow. The perturbation velocity potential is evaluated at the vertices of a lattice of Mach lines on each wing. The results of the application of the method to a wing-tailplane configuration each of triangular planform, are given.
Author

N71-29338# Advisory Group for Aerospace Research and Development, Paris (France)

SYMPOSIUM ON UNSTEADY AERODYNAMICS FOR AEROELASTIC ANALYSES OF INTERFERING SURFACES, PART 2

Apr 1971. 234 p. refs. Held at Tonsberg, Norway, 3-4 Nov 1970.

(AGARD-CP-80-71) Avail NTIS

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1 SUBSONIC UNSTEADY AIRLOADS ON MULTIPLE LIFTING SURFACES. G. Boehm and H. Schmid (Vereinigte Flugtechnische Werk-Fokker G m b H., Munich, West Germany). 28 p. refs.

2 NEW DEVELOPMENTS AND APPLICATIONS OF THE SUBSONIC DOUBLET-LATTICE METHOD FOR NONPLANAR CONFIGURATIONS. W. P. Rodden, J. P. Giesing, and T. P. Kalman (Douglas Aircraft Co., Inc., Long Beach, Calif.). 28 p. refs.

3 APPLICATION OF AFFDL UNSTEADY LOAD PREDICTION METHOD TO INTERFERING SURFACES. W. J. Mykutow, J. J. Olsen, and S. J. Pollock (AFSC, Wright-Patterson AFB, Ohio). 24 p. refs.

4 APPLICATION OF UNSTEADY AIRFORCE CALCULATION METHODS TO AGARD INTERFERENCE CONFIGURATIONS. D. E. Davies (RAE, Farnborough, England). 18 p.

5 MEASUREMENT OF UNSTEADY AIR LOADS OF INTERACTION BETWEEN LIFTING SURFACES IN TANDEM. A. Destuynder (Office Natl d'Etudes et de Recherches Aérospatiales, Paris, France). 12 p. refs.

6 T-TAIL AEROELASTIC ANALYSIS FOR FOKKER F 28. J. Yff and R. J. Zwaan (Vereinigte Flugtechnische Werke-Fokker G m b H., Munich, West Germany). 15 p. refs.

7 SOME RECENT INVESTIGATIONS ON FLUTTER IN SUBSONIC FLOW, CAUSED BY INTERFERENCE AERODYNAMIC FORCES BETWEEN WING AND TAIL OF A VARIABLE GEOMETRY AIRCRAFT. W. Seidel and O. Sensburg (Messerschmitt-Boelkow-Blohm G m b H., Munich, West Germany). 10 p. refs.

8 UNSTEADY AERODYNAMICS FOR WINGS WITH CONTROL SURFACES. H. Tijdeman and R. J. Zwaan (Natl Aero- and Astron Res Inst). 15 p. refs.

9 APPLICATION OF LIFTING SURFACE THEORY TO WINGS PROVIDED WITH CONTROL SURFACES. B. Darras and R. Dat (Office Natl d'Etudes et de Recherches Aérospatiales, Paris, France). 14 p. refs.

10 UNSTEADY AIRFORCES FOR WINGS WITH CONTROL SURFACES PART 1. LOADING FUNCTIONS. B. L. Hewitt (British Aircraft Corp., Warton, England). 26 p. refs.

11 UNSTEADY AIRFORCES FOR WINGS WITH CONTROL SURFACES PART 2. CALCULATION METHODS. B. L. Hewitt (British Aircraft Corp., Warton, England). 24 p. refs.

12 PRESSURE MEASUREMENTS ON AN HARMONICALLY OSCILLATING SWEEP WING WITH TWO CONTROL SURFACES IN INCOMPRESSIBLE FLOW. H. Försching, H. Triebstein, and J. Wagener (Deutsche Forschungsgemeinschaft Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen, West Germany). 15 p. refs.

N71-29339# Vereinigte Flugtechnische Werk-Fokker G m b H., Munich (West Germany)

SUBSONIC UNSTEADY AIRLOADS ON MULTIPLE LIFTING SURFACES

G. Boehm and H. Schmid. In AGARD Symp on Unsteady Aerodynamics for Aeroelastic Analyses of Interfering Surfaces, Part 2. Apr 1971. 28 p. refs.

Avail NTIS

A survey is presented of the main features of lifting lattice methods and particularly of lifting surface methods. Ways to extend existing methods to arbitrary lifting surface configurations are also discussed. The following is a short description of these fundamentals and a detailed discussion of the numerical methods as established by the authors. Results obtained will be presented and compared with other theories.
Author

N71-29340# Douglas Aircraft Co., Inc., Long Beach, Calif.
NEW DEVELOPMENTS AND APPLICATIONS OF THE SUBSONIC DOUBLET-LATTICE METHOD FOR NONPLANAR CONFIGURATIONS

W. P. Rodden, J. P. Giesing, and T. P. Kalman. In AGARD Symp

on Unsteady Aerodynamics for Aeroelastic Analyses of Interfering Surfaces, Part 2 Apr 1971 28 p refs
 Avail NTIS

Procedures for calculating the normalwash induced by a doublet line in nonplanar configurations and for calculating the interference between wings and bodies are given. Applications are made to a non-coplanar wing-tail combination, a number of empennage configurations, a wing-fuselage and a wing-nacelle combination. Also considered is the calculation of velocity components in the flow field during oscillatory motion and the calculation of the distribution of induced drag in steady flow. Examples of both calculations are also presented. Author

N71-29341# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab

APPLICATION OF AFFDL UNSTEADY LOAD PREDICTION METHOD TO INTERFERING SURFACES

W J Mykytow, J J Olsen and S J Pollock. In AGARD Symp on Unsteady Aerodynamics for Aeroelastic Analyses of Interfering Surfaces, Part 2 Apr 1971 24 p refs
 Avail NTIS

The results of engineering applications of subsonic and supersonic lifting surface methods to some of the AGARD configurations and other interesting configurations, are presented. The subsonic kernel function program is applied to several aspects of the wing-tail interaction problem. The subsonic double lattice method is also applied to the problem. Results are also presented for a supersonic Mach box program developed for T-tails and cruciform tails along with comparisons with piston theory. Comparison between the subsonic kernel function and the doublet lattice method is generally quite good. While the double lattice method usually required greater computing times for the same accuracy as the kernel function method, it has some advantages in its favor such as ease of application and extension to more complicated configurations. The supersonic results presented here appear to be of the proper order of magnitude when compared with piston theory, however, more applications and careful checking are indicated. Author

N71-29342# Royal Aircraft Establishment, Farnborough (England)
APPLICATIONS OF UNSTEADY AIRFORCE CALCULATION METHODS TO AGARD INTERFERENCE CONFIGURATIONS

D E Davies. In AGARD Symp on Unsteady Aerodynamics for Aeroelastic Analyses of Interfering Surfaces, Part 2 Apr 1971 18 p

Avail NTIS

Calculations of generalised airforce coefficients were carried out for the configurations of wing and horizontal tail and of fin and horizontal tail oscillating in subsonic flow in prescribed modes at given frequencies. Author

N71-29343# Office National d'Etudes et de Recherches Aérospatiales, Paris (France)

MEASUREMENT OF UNSTEADY AIR LOADS OF INTERACTION BETWEEN LIFTING SURFACES IN TANDEM [MESURES DES FORCES INSTATIONNAIRES D'INTERACTION ENTRE SURFACES PORTANTES EN TANDEM]

A Destuynder. In AGARD Symp on Unsteady Aerodynamics for Aeroelastic Analyses of Interfering Surfaces, Part 2 Apr 1971 12 p refs. In FRENCH, ENGLISH summary

Avail NTIS

A series of wind tunnel tests were performed in view of analyzing the influence of several parameters on the aerodynamic interference between two lifting surfaces in tandem. The aim was to determine the magnitude of the coupling terms in order to provide a theoretical explanation of the flutter instabilities occurring on variable sweep airplanes. The tests were limited to two types of motion: pure translation and pure pitching oscillation of one wing. The model consisted of two rectangular or swept wings whose relative position could be adjusted continuously in the horizontal as well as in the vertical direction. Some comparisons between theory and experiment are given. Author

N71-29344# Vereinigte Flugtechnische Werke-Fokker G m b H, Munich (West Germany)

T-TAIL AEROELASTIC ANALYSIS FOR FOKKER F.28

J Yff and R J Zwaan (Natl Aero and Astronautical Res Inst). In AGARD Symp on Unsteady Aerodynamics for Aeroelastic Analyses of Interfering Surfaces, Part 2 Apr 1971 15 p refs

Avail NTIS

Data from an aeroelastic and flutter analysis are presented. The data include lateral gust loading, aircraft designs, and mission analysis. The results indicate that mass balancing of the rudder and aileron may be deleted, testing time for high speed flutter may be reduced, and the risks of extensive modifications to the design may be reduced. The tests also achieved the certification of the aircraft. E H W

N71-29345# Messerschmitt-Boelkow-Blohm G m b H, Munich (West Germany)

SOME RECENT INVESTIGATIONS ON FLUTTER IN SUBSONIC FLOW, CAUSED BY INTERFERENCE AERODYNAMIC FORCES BETWEEN WING AND TAIL OF A VARIABLE GEOMETRY AIRCRAFT

W Seidel and O Sensburg. In AGARD Symp on Unsteady Aerodynamics for Aeroelastic Analyses of Interfering Surfaces, Part 2 Apr 1971 10 p refs

Avail NTIS

A method for routine flutter calculations utilizing interference aerodynamic forces between wing and tail is presented. The elastomechanic system of the aircraft is described by branch modes and the airforces for these branch modes are produced by superimposing air forces for arbitrary polynomials. The air forces are calculated for a distinct vertical offset between wing and tail with the exact kernel functions. A large variety of stiffness parameter variations was performed such as wing stiffness, fuselage stiffness and tailplane connection stiffness in order to get a better understanding of the flutter phenomenon involved and to find a cure for solving the problem. Some of the results are compared with results from wind tunnel model tests to establish the validity of the analytical method used. Author

N71-29346# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands)

UNSTEADY AERODYNAMICS FOR WINGS WITH CONTROL SURFACES

H Tijdeman and R J Zwaan. In AGARD Symp on Unsteady Aerodynamics for Aeroelastic Analyses of Interfering Surfaces, Part 2 Apr 1971 15 p refs

Avail NTIS

A kernel function method to calculate pressure distributions over wings with harmonically oscillating control surfaces in subsonic flow is briefly discussed. Comparisons of calculated and measured pressure distributions are given for different planforms, Mach

numbers and reduced frequencies. An analysis is given of pressure distributions measured at high subsonic and transonic Mach numbers
Author

N71-29347# Office National d'Etudes et de Recherches Aérospatiales Paris (France)

APPLICATION OF LIFTING SURFACE THEORY TO WINGS PROVIDED WITH CONTROL SURFACES [APPLICATION DE LA THEORIE DE LA SURFACE PORTANTE A DES AILES MUNIES DE GOUVERNES]

B Darras and R Dat / In AGARD Symp on Unsteady Aerodynamics for Aeroelastic Analyses of Interfering Surfaces, Part 2 Apr 1971 14 p refs In FRENCH, ENGLISH summary

Avail NTIS

A method for solving the problem of control surfaces in subsonic unsteady flow is considered. It is based on the explicitation of the logarithmic singularity of the pressure field and on an analysis of the usual matrix solution of the integral equation. This method, whose application to a rectangular wing has already been described, is extended here to an arbitrary planform. The comparison of experimental and theoretical results obtained for the rectangular wing is also shown
Author

N71-29348# British Aircraft Corp., Warton (England)

UNSTEADY AIRFORCES FOR WINGS WITH CONTROL SURFACES. PART 1: LOADING FUNCTIONS

B L Hewitt / In AGARD Symp on Unsteady Aerodynamics for Aeroelastic Analyses of Interfering Surfaces, Part 2 Apr 1971 26 p refs

Avail NTIS

An attempt was made, through the use of matched asymptotic expansion techniques, to define methods for finding the inner singular pressure loading functions associated with a wide variety of interaction effects on wings with unbalanced control surfaces. The work is basic in that it facilitates the construction of adequate loading forms which are necessary before attempting to obtain convergent lifting surface theory solutions. It extends the practical scope of Landahl's work and gives, as a result, sound reasons for modifying the loading recipes
Author

N71-29349# British Aircraft Corp., Warton (England)

UNSTEADY AIRFORCES FOR WINGS WITH CONTROL SURFACES. PART 2: CALCULATION METHODS

B L Hewitt / In AGARD Symp on Unsteady Aerodynamics for Aeroelastic Analyses of Interfering Surfaces, Part 2 Apr 1971 24 p refs

Avail NTIS

Using the local loading solutions, a numerical method is described which accurately evaluates the associated discontinuous downwash distribution, $w(2)$, for steady flow $W(2)$ is then regularised through the specified boundary conditions to give $w(1)$, which can then be used to gain converged solutions for the residual loading. Full loading solutions are found for rectangular wing with control surface configurations in incompressible flow, and the results compared with other methods. The form of $w(1)$ is calculated on a simple swept wing with control surface configuration, and is found to become irregular near the hinge line corners. Modifications to the originally chosen special loading form are suggested which should lead to convergent loading solutions for swept wings
Author

N71-29350# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany)

PRESSURE MEASUREMENTS ON AN HARMONICALLY OSCILLATING SWEEP WING WITH TWO CONTROL SURFACES IN INCOMPRESSIBLE FLOW

H Forschung, H Triebstein, and J Wagener / In AGARD Symp on Unsteady Aerodynamics for Aeroelastic Analyses of Interfering Surfaces, Part 2 Apr 1971 15 p refs
Avail NTIS

The results of an experimental study of the pressure singularities occurring along the control surface edges of a harmonically oscillating swept wing control surface system in incompressible flow are presented and discussed. The two control surfaces ranged along the whole span of the wing and could be excited so that alternatively the inner or the outer flap or even both were oscillating with different phases and amplitudes relative to each other and relative to the wing
Author

N71-29361# Royal Aircraft Establishment, Farnborough (England)

NOMOGRAMS FOR THE CALCULATION OF MULTIPATH EFFECTS ON VHF AND UHF AIRCRAFT RADIO LINKS

G May May 1970 28 p refs

(RAE-TR-70097) Copyright Avail NTIS

Expressions are derived for the difference in transmission times and the frequency of fading due to the multipath propagation of signals between two aircraft. Nomograms are presented both for the general and the simplified cases. The latter occur when approximations can be made because the sum of the heights of the two aircraft is much less than the distance between them
Author (ESRO)

N71-29374# Deutsche Forschungs und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany) Inst fuer Luftsaugende Antriebe

INTRODUCTION TO THE PHYSICAL FUNDAMENTALS OF COMPRESSOR NOISE [EINFUEHRUNG IN DIE PHYSIKALISCHEN GRUNDLAGEN DES LAERMS VON AXIALVERDICHTERN]

Dieter Lohmann Dec 1970 222 p refs In GERMAN, ENGLISH summary

(DLR-FB-70-74) Avail NTIS, ZLDI Munich 31,50 DM

A survey of a large number of reports on noise generated by fans and compressors is presented. A comprehensive review is given of the fundamentals of compressor aeroacoustics and the origins of compressor noise. Possibilities for reducing compressor noise are discussed
Author (ESRO)

N71-29378# Aeronautical Research Inst of Sweden, Stockholm

FFA STRUCTURAL RESEARCH AND TEST FACILITIES

1970 64 p

(FFA-MEMO-61) Avail NTIS

Main activities of test facilities on structural engineering at FFA, Sweden, are described as well as the test equipment. Other facilities serving the FFA Structures Department are reviewed
ESRO

N71-29395# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany) Abteilung Aerodynamik

RESULTS OF THE THEORY OF ROTOR FLOW ACCORDING TO MILLER AND SCULLY [ERGEBNISSE DER THEORIE DER ROTORDURCHSTROEMUNG NACH MILLER UND SCULLY]

Jost Wilhelm Fuhr Jan 1970 37 p refs In GERMAN, ENGLISH summary

(DLR-MITT-70-23) Avail NTIS, ZLDI Munich 8 DM

A brief survey on different methods of rotor downwash analyses, according to several publications dealing with this problem, is presented. From the multitude of existing theories a simple and a rather difficult method are selected, improved, and compared. Author (ESRO)

N71-29430# Massachusetts Inst of Tech, Cambridge Electronic Systems Lab

STUDIES RELATED TO THE OPTIMAL CONTROL AND STABILIZATION OF AIRCRAFT IN THE PRESENCE OF GUST LOAD DISTURBANCES Status Report, 15 Jun 1970 - 31 Jan. 1971

S K Mitter 1971 5 p refs

(Grant AF-AFOSR-1941-70)

(AD-722072, AFOSR-71-0941) Avail NTIS CSCL 1/3

The objective of this research is to develop a theory of controllability for parabolic and second order hyperbolic systems and for hereditary differential systems. An attempt is made to use abstract semi-group theory and spectral theory to develop the necessary results. It is proposed to apply these ideas to the stabilization problem of high speed aircrafts in the presence of severe gust load disturbances. Author (GRA)

N71-29433# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany) Abteilung Aeroelastik

PRESSURE MEASUREMENTS ON AN HARMONICALLY OSCILLATING SWEEP WING WITH TWO CONTROL SURFACES IN INCOMPRESSIBLE FLOW

H Foersching, H Triebstein, and J Wagener Sep 1970 33 p refs Presented at the Symp on Unsteady Aerodyn of Interfering Surfaces, Tonsberg, Norway, 3-4 Nov 1970 (DLR-FB-70-47, AVA-FB-7025) Avail NTIS, ZLDI Munich 10,50 DM

The results of an experimental study of the pressure singularities occurring along the control surface edges of a harmonically oscillating swept wing control surface system in incompressible flow are presented and discussed. The two control surfaces ranged along the whole span of the wing and could be excited so that alternatively the inner or the outer flap or even both were oscillating with different phases and amplitudes relative to each other and relative to the wing. Author (ESRO)

N71-29438# Royal Aircraft Establishment, Farnborough (England) **THE CALCULATION OF THE DIVERGENCE FACTOR CHARACTERISTIC OF EARTH REFLECTED SIGNALS ON AIR-TO-AIR RADIO LINKS**

G May Nov 1970 19 p refs

(RAE-TR-70210) Copyright Avail NTIS

An exact cubic equation is derived for locating the reflection point that occurs due to multipath propagation between two aircraft, so that the divergence factor for the reflected radiation can be calculated. It is shown that when the ratio of the heights of the two aircraft is large, approximations can be made leading to a quadratic equation. Two examples of divergence factor calculations are given using nomographic techniques for determining and checking the reflection point position. Possible extensions of these techniques to other aircraft height ratio cases are indicated. Author (ESRO)

N71-29496# Technische Hogeschool, Delft (Netherlands) Vliegtuigbouwkunde

MATHEMATICAL MODEL OF EXTERNAL DISTURBANCES ACTING ON AN AIRCRAFT DURING AN ILS APPROACH AND LANDING

O H Gerlach and J Schuring Mar 1970 52 p refs

(VTH-159) Avail NTIS

Three different types of disturbances are distinguished: the wind, atmospheric turbulence and the noise contained in the ILS signals. The model is thought to be applicable to altitudes between ground level and 250 m. The basic material from which the model has been constructed has been compiled from available literature. Author (ESRO)

N71-29497# Royal Aircraft Establishment, Farnborough (England) **FLIGHT TRIALS TO DISCOVER WHETHER PERIPHERAL VISION IS NEEDED FOR LANDING**

B D Armstrong Nov 1970 36 p refs

(RAE-TR-70205) Copyright Avail NTIS

The results of flight trials, at night and in low visibility, with restricted peripheral vision are described. They were undertaken to discover whether lack of peripheral vision was a major cause of poor landing performance on conventional aircraft flight simulators. The results show that landing performance in flight is almost unaffected by loss of peripheral vision, even in poor visibility. Author (ESRO)

N71-29500# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div **THEORY OF JET ENGINES**

A L Kiyachkin 21 Jan 1971 681 p refs Transl into ENGLISH of the book "Teoriya Vozdushno-Reaktivnykh Dvigatelye" Moscow 1969 p 1 512

(AD-722283, FTD-MT-24-123-70) Avail NTIS HC \$9.00/MF \$0.95 CSCL 21/5

The book examines the design operating process, principles of control and operational characteristics of jet engines of various types used in civil aviation (including turbojet, turboprop and turbofan). The classification of the engines is given. Special attention is given to the analysis of peculiarities of throttle and high-altitude and high-speed characteristics of gas-turbine aircraft engines and also the study on the effect of various operating conditions on these characteristics. Author (GRA)

N71-29543# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany) Abteilung Schwingungen

CALCULATION OF THE UNCOUPLED VIBRATIONS OF HELICOPTER ROTOR BLADES USING THE METHOD OF TRANSFER MATRICES. EFFECTS OF AERODYNAMIC DAMPING, A BUILT-IN CONE ANGLE AND COMPARISON WITH OTHER THEORETICAL METHODS AND MEASUREMENTS [BERECHNUNG DER UNGEKOPPELTEN SCHWINGUNGEN VON HUBSCHRAUBER-ROTOR-BLAETTERN MIT HILFE DER UEBERTRAGUNGSMATRIZEN-METHODE. EINFLUSS DER AERODYNAMISCHEN DAEMPFGUNG, EINES EINGEBAUTEN KONUSWINKELS UND VERGLEICH MIT ANDEREN RECHENMETHODEN UND MESSUNGEN]

Siegfried Benz Nov 1970 96 p refs In GERMAN, ENGLISH summary

(DLR-FB-70-63) Avail NTIS ZLDI Munich 15,50 DM

The method of transfer matrices allows a relatively clear and simple solution of the problems of rotor blade vibrations, especially by use of digital computers. The uncoupled flapwise chordwise and torsional vibrations are dealt with. For the flapwise bending vibration, the interharmonic coupling effects owing to aerodynamic damping are taken into account. A built-in cone angle for hingeless rotors is considered for flapwise vibrations. The transfer matrix method is compared with other theoretical methods and experimental results. Author (ESRO)

N71-29551# Electromagnetic Compatibility Analysis Center, Annapolis, Md
THIRD-ORDER-TWO SIGNAL INTERMODULATION PRODUCTS FOR 242 FREQUENCIES BETWEEN 225-400 MHz

John M. Morrow (IIT Research Inst., Annapolis, Md.) Nov 1970 98 p. Prepared for FAA, Washington, D.C.
 (Contract F19628-70-C-0291)
 (ECAC-PR-70-018) Avail NTIS

A series of reports are presented which are designed as handbooks to be used in FAA frequency assignment processes. Their sole purpose is to identify third order-two signal intermodulation products and their contributing frequency pairs. These matrices include all third order-two signal intermodulation products within the 118-136 MHz and 225-400 MHz band produced by mixtures of all possible pairs of selected channels. These products are of the form $2F_1 - F_2$ and $2F_2 - F_1$. Author

N71-29552# Electromagnetic Compatibility Analysis Center, Annapolis, Md

THIRD ORDER-TWO SIGNAL INTERMODULATION PRODUCTS, 118-136 MHz: 50 kHz CHANNEL SPACING INDEXED BY INTERMODULATION PRODUCT

John M. Morrow (IIT Research Inst., Annapolis, Md.) Nov 1970 125 p. Prepared for FAA, Washington, D.C.
 (Contract F19628-70-C-0291)
 (ECAC-PR-70-016) Avail NTIS
 For abstract see N71-29551

N71-29553# Department of Trade and Industry, London (England) Telecommunications Engineering Headquarters
MOVEMENT OF EMERGENCY VEHICLES IN REDUCED VISIBILITY CONDITIONS. REPORT ON ASMI/TRANSPONDER TRIALS AT HEATHROW AIRPORT, SEPTEMBER 1970

A. R. Hillier and A. P. Fuggle. 1970. 28 p. / Its Tels R3A Note 2/70, Issue 1
 Avail NTIS

The ASMI/Transponder tests for moving emergency service vehicles on airfields during poor visibility conditions are evaluated. The transponder was tested on a Nubian fire tender. Signals from the ASMI were used to interrogate the transponder at Q band, and by transmission of the ASMI picture to the vehicle via the microwave link. It is concluded that the simplest and cheapest arrangement is the provision of transponders on selected vehicles, and requires continuous guidance information to the vehicle by ATC Transponder cover from all areas of the airfield could be provided. FOS

N71-29554# Electromagnetic Compatibility Analysis Center, Annapolis, Md. Federal Aviation Agency, Washington, D.C.

THIRD ORDER TWO SIGNAL INTERMODULATION PRODUCTS, 118-136 MHz 50 KHz CHANNEL SPACING INDEXED BY CONTRIBUTING FREQUENCIES

John M. Morrow (IIT Res. Inst.) Nov 1970. 138 p. Prepared for FAA
 (Contract F19628-70-C-0291)
 (ECAC-PR-70-015) Avail NTIS
 For abstract see N71-29551

N71-29555# Environmental Science Services Administration, Boulder, Colo
MODULATION CHARACTERISTICS CRITICAL TO FREQUENCY PLANNING FOR THE AERONAUTICAL SERVICES

R. W. Hubbard, D. V. Glen, and W. J. Hartman. Apr 1970. 191 p. refs.
 (Contract FA-67-WAI-134)
 (ESSA-TM-ERL-ITS-232) Avail NTIS

The fundamental characteristics of basic analog and digital modulation processes used in the Air Traffic Control (ATC) communication system are summarized. These characteristics have been condensed into a format in which they may be readily applied to the spectrum planning phases of ATC system design. Single channel modes of transmission are primarily considered for voice and data signals, but many of the aspects considered are also useful in describing the baseband signal structure for multichannel systems in which multiplex transmission modes are used. The purpose is to provide a basic set of signal descriptors and characteristics at several stages in a total ATC communication circuit. The tabulated characteristics may be applied systematically to help determine the initial channel spacing, allocation, and power requirements for a particular system in a given frequency band. Author

N71-29557# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div
USING A HELICOPTER FOR DUSTING FOREST SOURCES OF TICK-BORNE ENCEPHALITIS

V. A. Nabokov et al. 20 Feb 1970. 7 p. refs. Transl. into ENGLISH from Med. Parazit. i Parazitarn. Bolezi (Moscow), v. 33, no. 1, 1964. p. 64-68.
 (AD-703998, FTD-HT-23-644-69) Avail NTIS

The MU 1HX helicopter was tested for spray dusting with a 10 percent DDT dust in tick borne encephalitis foci. During the period of spraying the flight speed of the craft was kept within limits of 30 to 35 km per hour. The improved precipitation of the chemical poison permitted it to reduce its consumption rate down to 20 kg per hectare, as compared with that (50 kg per hectare) accepted for the plane AH 2. The treatment remained highly effective. In addition to considerable savings of the poisonous material the reduction of consumption rates brought with it a substantial improvement of the present economic indices. This warrants recommending the new mode of the treatment for a wide scale field application in the foci of tick borne encephalitis. Author

N71-29562# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div
HYDRAULICS AND ITS APPLICATIONS ON AIRCRAFT
 B. B. Nekrasov. 14 Jan 1970. 402 p. refs. Transl. into ENGLISH of the book "Gidravlika i Yeye Primeneniye na Letatel'nykh Apparatakh" Moscow, Izd-Vo Mashinostroyeniye, 1967. p. 1-368.
 (AD-701974, FTD-HT-23-242-69) Avail NTIS. HC \$6.00/MF \$0.95

The application of hydraulic systems to the operation of aircraft is discussed. Subjects presented are (1) fundamentals of hydrostatics, (2) fundamental equations of hydraulics, (3) relative and nonsteady motion of fluid in pipes, (4) hydraulic drives and hydraulic transmissions, (5) design of hydraulic equipment for aircraft use, and (6) characteristics of centrifugal pumps. P N F

N71-29607*# General Electric Co., Philadelphia, Pa

H2 FUEL SYSTEM INVESTIGATION

W Collier. In NASA Marshall Space Flight Center Proc. Space Transportation System Propulsion Technol. Conf., Vol. 3. 28 Apr 1971. p. 1191-1224.

Avail. NTIS CSCL 211

Progress in designing and developing an air breathing engine system for space shuttle application is reported. Tasks included a parametric evaluation of various engine cycles employing hydrogen fuel, an engine design study, engine development plan and cost estimate, and performance specification. All work is completed, and a derivative of the F-101 engine was recommended and used as the referenced engine. While the hydrogen versus jet propulsion fuel evaluation is not yet complete, it appears that the use of hydrogen requires additional development in the fuel handling system and related control and accessory areas. No basic technological barriers were identified, however, for fitting an engine of this type to the desired application. A C R

N71-29622 National Lending Library for Science and Technology, Boston Spa (England)

NOISE DUE TO FLUID FLOW

19 Jan 1971. 4 p. Transl. into ENGLISH from Ver. Deut. Ing. Z. (West Germany), v. 112, 1 Apr 1970. p. 423.

(NLL-CE-Trans-5424-(9022 09)) Avail. Natl. Lending Library, Boston Spa, Engl. 1 NLL photocopy coupon.

A survey of the various forms and causes of flow induced noise is presented. The causes of noise associated with discharge effects, propellers, blowers, jet engines, boundary layers, water pipes, and supersonic aircraft are described and, where possible, empirical formulas for the expected acoustic power are given. A theoretical treatment of flow induced noise is included. Author

N71-29635# Federal Aviation Administration, Oklahoma City, Okla. National Flight Inspection Div.

EVALUATION OF IFR DEPARTURE PROCEDURE, ALBUQUERQUE, N. M., RUNWAY 08 Final Report

Norman C. Heidger, Harold R. Richards, and Frank Parr. May 1971. 28 p.

(FAA-FS-600-2) Avail. NTIS

A flight simulator study was made of an IFR departure procedure from a runway. Hot day temperature and calm surface winds were used for initial tests. Normal values were used to simulate actual ABQ conditions for easterly wind flows. 64 departures were made by 5 qualified pilots in the Boeing 720 flight simulator. A statistical analysis was made of recorded flight tracks to determine the average maximum distances and to calculate the 95 and 99 percent confidence limits of these averages. Left and right turns were flown, with specified turning heights of 400 and 700 feet above ground level. Statistically derived 99% upper limits of the average maximum flight track distances were obtained. Author

N71-29657# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ANALYTICAL METHODS FOR PROJECTED CONSTRUCTION OF WINGS

I. S. Golubev. 28 Dec 1970. 313 p. refs. Transl. into ENGLISH of the book "Analit. Metody Proektir. Konstruktsii Krylev" USSR, 1970. p. 1-288.

(AD-722303, FTD-HC-23-592-70) Avail. NTIS HC \$6.00/MF \$0.95 CSCL 1/3

This book contains an investigation of two interrelated problems: finding optimal material distribution in the wing structure and selecting the structural-technological solutions. The optimal law of material distribution is found by the methods of nonlinear programming. On the basis of replacing a variable function by a set of discrete parameters, the calculational relations (critical functions, conditions, restrictions) corresponding to the numerical and analytical methods of solving the design problem and various calculational schemes for the wing are obtained. First, the simplest cases are presented - single load system, absence of heating, isotropic structure, etc. On the basis of these cases, general relations are derived permitting consideration of the effect of aerodynamic heating, the load spectrum, and pliability of the wing fastening. The transition from the calculational scheme to the structural scheme and selection of the optimal structural-technological version of the wing are carried out on the basis of analyzing the additional weight, sources of which are the stability of the structural elements, reliability, technological factors and operating conditions. Author (GRA)

N71-29660# Matrix Research Co., Falls Church, Va.

DESIGN OF A COMPUTER ASSISTED COASTAL INFORMATION SYSTEM. PHASE 3: MODELING THE NAVY ECOSYSTEM Final Report, 12 Jan. 1970-21 Apr. 1971

Robert D. Campbell and A. L. Roark. 21 Apr 1971. 74 p. refs. (Contract NO0014-70-C-0215)

(AD-722427) Avail. NTIS CSCL 15/4

In this research effort our goal has been to determine what kind of information system about coastal areas would meet some large spectrum of Navy needs. In previous reports we reached the conclusion that to accomplish this goal we would need to construct some kind of model of the Navy ecosystem. We suggested that the bases for such a model be real information from the Navys record of interactions among coastal environments, Navy weapons systems, and basic Navy functions. We therefore used as source data the reports and publications of Navy activities associated with design, development, test, and evaluation of weapons systems and their components. Our objective was to describe the Navy ecosystem in rigorous enough fashion that our model would provide the logic for a coastal information system. Our model is therefore expressed in three ways: verbally, mathematically, and in information systems terms. The purpose of all these expressions of the same model is to provide the bases for an aggregating, integrating process which will relate environment to naval weapons systems in terms of naval functions. We believe that the structure we have described provides the framework for information systems not only for Navy but also for a wide gamut of evaluation and design activities which concern the man-environment interaction. Author (GRA)

N71-29690# Technische Univ., Berlin (West Germany). Fakultät fuer Maschinenwesen.

CONTRIBUTION TO THE THEORETICAL TREATMENT OF THE HUB EFFECT IN PROPELLER DESIGN (BEITRAG ZUR THEORETISCHEN BEHANDLUNG DES NABENEINFLUSSES BEIM PROPELLERENTWURF)

Carsten Oestergaard (Ph.D. Thesis). 1969. 77 p. refs. In GERMAN. Avail. NTIS

The displacement effect of the propeller hub in the potential wake flow produces pronounced changes in the flow field of the propeller blade. Computer calculations for effective propeller design,

using the lift line model to provide optimal boundary conditions for the circulation distribution around the hub, showed that the theory is not sufficient to describe all hydrodynamic processes around a propeller
Transl by G G

N71-29707# Committee on Interstate and Foreign Commerce (U S House)

AIR FARES AND CHARTER SERVICE

Washington GPO 1970 605 p refs Hearings before Comm on Interstate and Foreign Com , 91st Congr , 2d Sess , 10 Aug , 15-17 Sep , and 9 Oct 1970 /ts Serial No 91-80

Avail Subcomm on Transportation and Aeron

The hearings concerning problems of ticketed and charter services are reported. The CAB charter regulations concerning the requirements for legitimate chartering organizations are discussed. The cost report of the International Air Transport Association is included, and charter flights to the United States by foreign airlines are also discussed
F O S

N71-29708# Air Force Academy, Colo

AN APPROACH GUIDANCE SYSTEM FOR SIDE-FIRING TACTICAL AIRCRAFT

Bradford W Parkinson, Edward J Bauman, and Jack C Henry Oct 1970 45 p

(AD-722412, USAFA-TR-70-4) Avail NTIS CSCL 1/2

The present approach guidance scheme is one of controlling the aircrafts velocity vector, however, this scheme has two major disadvantages its a difficult flying task for the pilot, and when the aircraft arrives tangent to the circular path, a violent maneuver is usually required to achieve the proper bank angle to stay on the desired circular path. An improved method for controlling the side firing AC-130 and AC-119 into circular attack geometry eliminates these disadvantages. Furthermore, with this improved system the bank angle rates never exceed 3 or 4 degrees per second. This control scheme was simulated on the analog computer and the results are presented graphically. The simulation showed that the bank angle, command-control scheme is effective for distances out to five circular orbit radii from the target and is effective for all aircraft headings (with one exception which is discussed in a stability study in the appendix). The initial test flight showed that the bank angle control scheme behaved very well, and its overall performance was near that predicted. Relatively minor modifications can incorporate this control scheme into existing analog computers on board the aircraft
Author (GRA)

N71-29721# Vigo County Area Planning Dept, Terre Haute, Ind

AN AIRPORT STUDY FOR VIGO COUNTY, INDIANA

Aug 1970 153 p

(PB-197309, HUD-IND-70-11) Avail NTIS CSCL 13B

The airport study is basically an inventory and evaluation of the airports in Vigo County. The historical functioning of aviation in the planning area is discussed and Hulman Field and Sky King Airport are followed from their inception to their current operations. The report proceeds to supply a data bank on airport activity during the past ten years, including commercial, general and military air movements. The study also recognized any significant trends which may have transpired in the past five years. The study then provides an examination into the relationships between airports and comprehensive planning. Land use planning and transportation planning processes are interpreted according to their relevance in

achieving a harmonious and effective airport-neighboring environs relationship
Author.(GRA)

N71-29745*# National Aeronautics and Space Administration Lewis Research Center, Cleveland Ohio

EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF FAST NORMAL SHOCK POSITION CONTROLS FOR A MACH 2.5 MIXED-COMPRESSION INLET

George H Neiner, Michael J Crosby, and Gary L Cole Washington Jul 1971 64 p refs

(NASA-TN-D-6382, E-5932) Avail NTIS CSCL 21E

Simulation and experimental results are presented for several normal shock control systems using high-response (110-Hz bandwidth) overboard bypass doors. To date such control systems have used slower bypass doors (of the order of 10-Hz bandwidth). The best control, using two feedback loops and electronic compensation reduced shock motion below that without control for sinusoidal downstream airflow disturbances of up to 40 hertz. Inherent inlet dynamics constituted the main limitation on system closed-loop performance. Closed-loop control was demonstrated with the inlet terminated alternately with a long pipe, a choked orifice plate close to the diffuser exit station, and a J85-13 turbojet engine
Author

N71-29756# Lane Council of Governments, Eugene, Oreg
AIRPORT NEEDS STUDY FOR LANE COUNTY, OREGON

Jan 1971 91 p refs

(PB-197860) Avail NTIS CSCL 13B

The report identifies the public airports in Lane County, Oregon. The only commercial airport in the county, Mahlon Sweet Field, is examined as a regional and local airport facility. Projections of passenger and aircraft operations have been made at five year intervals through 1990. The development of the airport and the subsequent impact on land use is examined. The six general aviation airports in Lane County are also examined. Pilot, aircraft, and population distribution and land use are discussed prior to making recommendations for these airports
Author (GRA)

N71-29762# Massachusetts Inst of Tech, Cambridge Fluid Dynamics Research Lab

THE USE OF AERODYNAMIC LIFT FOR APPLICATION TO HIGH SPEED GROUND TRANSPORTATION Interim Report, Sep. 1969-Jun. 1970

Timothy M Barrows, Sheila E Widnall, and Herbert H Richardson Jun 1970 134 p refs

(Contract DOT-C-085-65)

(PB-197242, T70-3FRART-71-56) Avail NTIS CSCL 01A

The problem of a wing flying in very close proximity to a solid boundary, the so-called ram wing, is reviewed and a new solution is found using the method of matched asymptotic expansions. The effect of the wing upper and lower surface coordinates on the resulting pressure distribution is shown explicitly for the case of a two dimensional airfoil. It is shown that for very small clearance ratios a very simple expression is valid for the lift coefficient. On the basis of this simplification an analytic solution is obtained for the case of a flatplate airfoil operating above a sinusoidal ground plane, which gives the forces and moments due to ground bumps. The longitudinal dynamics of a tracked vehicle designed to utilize aerodynamic lift are then investigated
Dissert Abstr

N71-29774*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

POTENTIAL FLOW SOLUTION FOR A STOL WING PROPULSION SYSTEM

James A Albers and Merle C Potter Washington Jul 1971 35 p refs

(NASA-TN-D-6394, E-6132) Avail NTIS CSCL 01C

The analysis considers a two-dimensional wing-fan system which consists of an airfoil with flap, the fans, which have a distributed suction at their inlet and a jet at their exit, and a jet sheet leaving the flap trailing edge. The solution provides the incompressible potential flow for any value of fan or engine mass flow coefficient, the thrust coefficient for the propulsion system exhaust, and the wing and flap angle of attack. Flow fields, pressure distributions, and lift coefficients for a particular, externally blown flap, high-lift configuration are presented. Author

**N71-29775*# Massachusetts Inst of Tech, Cambridge
SUBSONIC STATIC CHARACTERISTICS OF SLENDER
WING CONFIGURATIONS USING A MAGNETIC
SUSPENSION AND BALANCE SYSTEM**

Milan Vlainac, Timothy Stephens, George Gilliam, Nicholas Pertsas, and Eugene Covert Washington NASA Jul 1971 26 p refs

(NASA-CR-1796, TR-168) Avail NTIS CSCL 01A

Aerodynamic forces and moments on three low-aspect-ratio wing planforms were obtained using a magnetic suspension and balance system. Comparison of the present data with both theory and experimental results obtained elsewhere is presented and shown to be in close agreement. Author

**N71-29777# Bolt, Beranek, and Newman, Inc., Cambridge, Mass
NOISE EXPOSURE FORECAST CONTOURS FOR EXPECTED
1985 AND 1990 OPERATIONS AT SEVEN US AIRPORTS**

Jan 1971 93 p refs

(AD-722365, BBN-2076) Avail NTIS CSCL 20/1

The report summarizes a study of the probable impact of future supersonic transport (SST) aircraft operations on the noise environment around seven airports in the United States. The noise environment is depicted in terms of Noise Exposure Forecast (NEF) contours of NEF 30 and 40 values for projected 1985 and 1990 operations at the following seven airports: Anchorage International Airport (ANC), Logan International Airport, Boston (BOS), Honolulu International Airport (HNL), John F Kennedy International Airport New York (JFK), Los Angeles International Airport (LAX), Seattle-Tacoma International Airport (SEA), San Francisco International Airport (SFO). Sets of noise contours are given for each airport for the two projections. Author (GRA)

**N71-29796# Army Test and Evaluation Command, Aberdeen
Proving Ground, Md
RELIABILITY Final Report**

10 Mar 1971 18 p

(AD-722721, MTP-7-3-508) Avail NTIS CSCL 14/4

The procedure defines methodology for evaluating the reliability of aircraft and related subsystems and allied equipment. Author (GRA)

**N71-29797# Army Test and Evaluation Command, Aberdeen
Proving Ground Md
INTERNAL/EXTERNAL LIGHTING Final Report**

12 Mar 1971 9 p refs

(AD-723034, MTP-7-3-527) Avail NTIS CSCL 1/3

Procedures are described for determining the functional suitability of internal/external lighting systems for U S Army aircraft. Author (GRA)

**N71-29893*# Massachusetts Inst of Tech, Cambridge
SECTION DATA FOR THIN, HIGHLY CAMBERED AIRFOILS
IN INCOMPRESSIBLE FLOW**

Jerome H Milgram Washington NASA Jul 1971 73 p refs
(Contract NAS1-8423)

(NASA-CR-1767) Avail NTIS CSCL 20D

The results of tests on thin, highly cambered sections are presented. The sections have sharp edges and are thin enough for the thickness effects to be negligible. There are some notable differences between the section characteristics of the thin, highly cambered sections and sections having less camber and more thickness. At the ideal angle of attack, as given by thin airfoil theory, the thin, highly cambered sections have about five times as much drag as do thicker sections of less camber. The lift of the thin, highly cambered sections at angles of incidence near ideal is significantly less than that predicted by thin airfoil theory because of the effects of flow separation. The flow separation on the pressure side is increased by a reduction of angle of attack from ideal. This results in lift slopes significantly greater than 2 pi per radian for angles of attack slightly less than the ideal angle of attack. Author

**N71-29895# Army Electronics Command, Fort Monmouth, N J
DUAL MODE SYMMETRICAL HIGH FREQUENCY ANTENNA
FOR AIRBORNE USE**

D V Campbell, J Arnold, H Inslerman, T Wilson Mar 1971 42 p refs

(AD-722736, ECOM-3404) Avail NTIS CSCL 9/5

A compact, self-contained symmetrical antenna (experimental) for airborne use at high frequencies has been developed and tested. Provisions for tuning are integrated with the radiating elements. A four-port hybrid is incorporated enabling the antenna to function in two independent modes for both transmission and reception. When symmetrically installed on a helicopter and operated in the antiphase mode, excitation of the aircraft is minimized, and a dipole pattern which is predominantly horizontally polarized obtains. When operated in the inphase mode the resulting pattern is omnidirectional and the polarization predominantly vertical. Radiation patterns are highly predictable and the rotor effect minimal. At frequencies in the lower HF range the novel antenna has somewhat greater gain than the much larger conventional wire antenna. Author (GRA)

**N71-29906# Naval Ordnance Lab, White Oak, Md
NOL HYPERVELOCITY WIND TUNNEL. REPORT NO 3.
THEORETICAL ANALYSIS OF THE BOUNDARY LAYER IN
THE NOZZLE**

Neal Tetervin 26 Feb 1971 45 p refs

(AD-722346, NOLTR-71-7) Avail NTIS CSCL 14/2

The equations used to calculate the boundary layer properties for use in the design of the Mach 10, 15, and 20 axisymmetric nozzles of the hypervelocity wind tunnel at NOL are derived. One equation is the integral moment-of-momentum differential equation for the boundary layer velocity profile shape parameter, the form of the equation is valid for a real gas. This equation is used with an axisymmetric integral momentum equation that is valid for thick as well as for thin boundary layers to calculate the total thickness and the displacement effect of the boundary layer. Author (GRA)

**N71-29907# Naval Ordnance Lab, White Oak Md
NOL HYPERVELOCITY WIND TUNNEL. REPORT NO 1.
AERODYNAMIC DESIGN**

E Leroy Harris and Walter J Glowacki 26 Feb 1971 64 p refs

(AD-722345, NOLTR-71-5) Avail NTIS CSCL 14/2

The NOL hypervelocity wind tunnel will provide a high Reynolds number turbulent flow simulation in the Mach number range 10 to 20. This facility, much needed for large-scale testing of hypersonic vehicles, is under construction and will be operational late in 1972. Supply pressures up to 40,000 psi will be maintained constant for 1 to 4 seconds during which stable, condensation-free flow conditions will prevail. Very high Reynolds numbers are obtained by operating with nitrogen at temperatures just sufficient to avoid test section condensation. The facility, which operates in a blowdown mode, has separate legs for the three design Mach numbers 10, 15, and 20. Each leg is fitted with its own storage heater, diaphragm assembly, contoured nozzle, and diffuser. The three legs share a common gas storage supply, test cell and model support system, and vacuum sphere. The report highlights the more significant considerations leading to the aerodynamic design of the facility and includes discussions of the need for the facility, the initial requirements imposed on its design, and brief descriptions of the layout and operation of the facility. Author (GRA)

N71-29914# National Transportation Safety Board, Washington, D C

AIRCRAFT ACCIDENT REPORT MISSISSIPPI VALLEY AIRWAYS, INCORPORATED DEHAVILLAND DHC-6, N956SM, LA CROSSE, WISCONSIN, 9 NOVEMBER 1970
5 May 1971 13 p
(NTSB-AAR-71-10) Avail NTIS

A Mississippi Valley Airways, Inc., DeHavilland DHC-6, N956SM, crashed at La Crosse, Wisconsin, on November 9, 1970, at approximately 1608 central standard time while executing a nonprecision instrument approach in instrument flight conditions. The aircraft struck trees approximately 4,000 feet from the threshold of runway 13 on approach centerline. The aircraft was destroyed by impact. The captain, first officer, and three of the four passengers sustained serious injuries. There was no post-crash fire. The National Transportation Safety Board determined that the probable cause of this accident was that for unknown reasons, the captain failed to maintain altitude at minimum descent altitude and allowed the aircraft to descend below the height of trees while executing a nonprecision instrument approach in instrument flight conditions. Author

N71-29920*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

JET PENETRATION INTO MACH 2 AIRSTREAM USING SWEEPED BACK INJECTORS AT ANGLE OF ATTACK
Martin Hersch and Louis A Povinelli Washington Jul 1971 28 p refs

(NASA-TM-X-2319, E-6159) Avail NTIS CSCL 20D

Helium was injected at sonic velocity normal to the leeward side of arrow-and delta-wing injectors. Vortex-controlling parameters including sweepback angle, swept-edge length, swept-edge wedge angle, and angle of attack were constant, but blockage and calculated drag were lower for the arrow injectors. The changes in vortex-enhanced penetration and lateral spreading were less rapid than the changes in blockage area and calculated drag. Also, helium, when injected from a porous area on the windward side, was swept over into the leeward vortex. Penetration in the vortex region was then greater than when helium was injected at sonic velocity directly into the vortex from the leeward side. Author

N71-30029# National Transportation Safety Board, Washington, D C

AIRCRAFT ACCIDENT REPORT: OVERSEAS NATIONAL

AIRWAYS, INCORPORATED, DOUGLAS DC-9, N935F OPERATING AS ANTILLIAANSE LUCHTVAART MAATSCHAPPIJ FLIGHT 980 NEAR SAINT CROIX, VIRGIN ISLANDS, 2 MAY 1970

31 Mar 1970 33 p

(NTSB-AAR-71-8, SA-420) Avail NTIS

Overseas National Airways Flight 980 (ALM), was ditched near St Croix. Forty persons, including 35 passengers and five crewmembers survived. Twenty-three persons, including two infants and the stewardess, did not survive. The aircraft sank in 5,000 feet of water and was not recovered. The flight departed Kennedy International Airport, N.Y., nonstop for St Maarten, Netherlands Antilles. After an ADF and three circling approaches in poor weather, during which a landing could not be made, the flight departed for St Croix. Enroute to St Croix in a low-fuel state, the aircraft was descended to the water in anticipation of a ditching. When fuel exhaustion was reached, the engines flamed out and the aircraft was ditched. Author

N71-30033# Joint Publications Research Service, Washington, D C

TRANSLATIONS ON EASTERN EUROPE: SCIENTIFIC AFFAIRS, NO. 181

22 June 1971 37 p refs Transl into ENGLISH from Polish, Rumanian, and Yugoslavian reports
(JPRS-53428) Avail NTIS

A review of scientific developments in East European countries is presented. Subjects discussed are (1) Polish geological exploration, (2) Soviet space technology findings, (3) development of ultrasonic flow detector, (4) operation of computer, (5) development of science in Romania, and (6) description of tactical aircraft used in European countries. P N F

N71-30039# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany) Abteilung Aerodynamik

CALCULATION OF THE INDUCED VELOCITY DISTRIBUTION OF A ROTOR IN STATIONARY FORWARD FLIGHT [BERECHNUNG DER INDUZIERTEN GESCHWINDIGKEITSVERTEILUNG EINES ROTORS IM STATIONAEREN VORWAERTSFLUG]

Jost Wilhelm Fuhr and Alfred Kussmann Mar 1970 53 p refs In GERMAN, ENGLISH summary
(DLR-MITT-70-22) Avail NTIS, ZLDI Munich 10.50 DM

A simplified method of rotor downwash calculation is described. The rotor wake system is substituted by discrete vortex lines according to the lifting line theory. A separation in a near wake system consisting of semi-infinite vortex lines and a far wake system with fore and aft infinite vortex lines is introduced for calculation. The digital computer program is described and analytical results are presented. Author (ESRO)

N71-30040# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany) Abteilung Aerodynamik

PARAMETRIC STUDIES OF ROTOR DOWNWASH CALCULATION. INFLUENCE ON FIXED WING FLOW [PARAMETERUNTERSUCHUNGEN ZUR ROTORABWINDBERECHNUNG. EINFLUSS AUF DIE UMSTROEMUNG EINES FLUEGELS]

Hans Bergmann and Jost W Fuhr Dec 1970 79 p refs In GERMAN, ENGLISH summary
(DLR-FB-70-62) Avail NTIS, ZLDI Munich 13 DM

Parametric studies have been conducted in order to determine the influence of vortex model variations on the downwash calculations of a given helicopter rotor. Additionally, a method to calculate the lift distribution of a fixed wing located in the rotor wake is presented, neglecting fuselage disturbance. Interactions of rotor and wing are shown. As a basis for wing aerodynamics the lifting line theory is employed. A rigid rotor wake model with helical vortex lines is used. Calculation of induction is accomplished by finite and straight vortex segments and/or by semi-infinite and straight vortex lines. Author (ESRO)

N71-30055*# National Aeronautics and Space Administration
Lewis Research Center, Cleveland Ohio

LEWIS 9- BY 15-FOOT V/STOL WIND TUNNEL

Joseph A Yuska, James H. Diedrich, and Nestro Clough
Washington Jul 1971 48 p refs

(NASA-TM-X-2305, E-6055) Avail NTIS CSCL 14B

The V/STOL wind tunnel was built in the return leg of the 8 by 6 foot supersonic wind tunnel. The test section has a velocity range of 13.4 to 78.2 meters per second. The features of the wind tunnel are described, and the results of the initial calibration are presented in sufficient detail to guide prospective users in designing experiments. The methods used to design the tunnel inlet section, the test section wall slot geometry, and the diffuser section are also described. Author

N71-30072*# National Aeronautics and Space Administration
Lewis Research Center, Cleveland Ohio

OPTIMAL CONTROL OF SUPERSONIC INLETS TO MINIMIZE UNSTARTS

Bruce Lehtinen, John R. Zeller, and Lucille C. Geyser
Washington Jul 1971 29 p refs

(NASA-TN-D-6408, E-6253) Avail NTIS CSCL 21E

A method for designing supersonic inlet controls based on a desire to minimize inlet unstart is described. The design problem is formulated as one in linear stochastic optimal control and estimation. However, the performance index chosen (to be minimized) is the expected frequency of unstarts. Since this index is nonquadratic, the principle of quadratic equivalence is applied, so that the control consists of linear state variable feedback. Estimates of unmeasurable and/or noisy states required for control are then generated using a Kalman filter. Results show the sensitivity of unstart frequency to nominal normal shock position, control bypass door capacity, and measurement noise level, for white noise disturbances. Author

N71-30117*# National Aeronautics and Space Administration
Lewis Research Center, Cleveland Ohio

PRELIMINARY INVESTIGATION OF GASEOUS EMISSIONS FROM JET ENGINE AFTERBURNERS

Larry A. Diehl
Washington Jul 1971 18 p refs

(NASA-TM-X-2323, E-6256) Avail NTIS CSCL 20M

Gaseous emissions from jet engine afterburners were measured over a range of fuel-air ratios. The two configurations used were a full-size turbofan engine with an afterburner and a 51-cm diameter research afterburner. Nitric oxide emission did not increase with afterburning. The maximum nitric oxide concentration measured with afterburning was 3.4 g/kg of fuel burned while the maximum measured carbon monoxide emission was 1300 g/kg of fuel burned. Appreciable quantities of unburned hydrocarbons resulted from operation at high fuel-air ratios. Nitric oxide concentrations were less than theoretical equilibrium values by as much as two orders of magnitude; concentrations of unburned products were always greater than equilibrium values. Author

N71-30128# Wetenschappelijk en Technisch Documentatie- en Informatiecentrum voor de Krijgsmacht, The Hague (Netherlands)

BIRD HAZARDS TO AIRCRAFT: A LITERATURE SURVEY VOLUME 2: OCTOBER 1967 - JANUARY 1971

H. Crop and G. A. J. Kerstens, comps.
Jan 1971 16 p refs
(TDCK-56961) Avail NTIS

The literature survey covers the period October 1967 to January 1971, and contains 22 abstracts. Author

N71-30164# Committee on Commerce (U.S. Senate)

WATERFRONT AND AIRPORT COMMISSION COMPACT ACT OF 1970

Magnuson
Washington GPO 1970 13 p refs
Report to accompany S. J. Res. 222 presented by Comm. on Com. at 91st Congr., 2d Sess., 2 Oct 1970

(Rept-91-1262) Avail US Capitol Senate Document Room

Hearings are presented on legislation which would extend the authority of the Waterfront Commission of New York Harbor to airports in the New York metropolitan area to reduce air cargo theft. The proposed bill provides the Commission with authority to license airfreightmen and airfreightman supervisor and to declare an area in an airport as an airfreight security area. Arguments advanced by the opponents and rejoinders by proponents are summarized. The modus operandi in the thefts, weaknesses in the bill, and suggestions to strengthen the bill are described. NEN

N71-30173# Systems Technology, Inc., Hawthorne, Calif

INVESTIGATION OF MEASURING SYSTEM REQUIREMENTS FOR INSTRUMENT LOW VISIBILITY APPROACH Final Report, Jul. 1969 - Jun 1970

Dunstan Graham, Warren F. Clement, and Lee Gregor Hofmann
Wright-Patterson AFB, Ohio AFFDL Feb 1971 220 p refs

(Contract F33615-69-C-1904)

(AD-722773, AFFDL-TR-70-102) Avail NTIS CSCL 1/2

A practical method of determining measuring system requirements for instrument low visibility approach is presented. The method is made to depend on system analysis of the airplane, its control system, and the guidance system, as well as on atmospheric turbulence inputs and radio guidance system fluctuation noise. Requirements on the system are set in terms of a low value of the accident exposure multiplier which is related to the probability of a missed approach in the assumed environment. The application of the method is demonstrated in connection with two examples: manual-flight director approach in the A-7D attack airplane, and automatically coupled approach with an advanced windproof flight control system in the DC-8 transport aircraft. The results, including particularly the implied requirements on scan rate for a scanning beam instrument low visibility approach system, demonstrate the interconnections between scanning rate, flight control, and overall system performance. Author (GRA)

N71-30174# Center for Naval Analyses, Arlington, Va. Inst of Naval Studies

NAVAL AIRSPACE USAGE: A SURVEY OF NAVY AND MARINE CORPS FLIGHT ACTIVITY

Lawrence E. Brumbach
Feb 1971 132 p refs
Its Res. Contrib 160

(Contract N00014-68-A-0091)

(AD-722698) Avail NTIS CSCL 1/2

A comprehensive data base is presented with detailed information on the manner in which airspace is used by Navy and Marine Corps operational squadrons. It is based on a nationwide

survey conducted in February and March, 1970. The conduct of the survey is described, and examples of the application of selected data are given. With emphasis on the interaction between operational flight training and the National Airspace System, statistical data is assembled on the use of airways, the Positive Control Area, Warning Areas, Restricted Areas, and related aspects of Naval flight activity. This research contribution is one of several documents produced in support of Project Blue Air. An Analysis of Naval Airspace Usage. A complete list of these documents is given in the project report, INS Study No 34. Author (GRA)

N71-30241*# Clemson Univ., S.C.
MINIMUM VARIANCE ESTIMATES OF SIGNAL DERIVATIVES: A PROBLEM IN INSTRUMENT LANDING SYSTEMS

J. C. Martin Dec 1970 17 p refs

(Grant NGR-41-001-024)

(NASA-CR-111928) Avail NTIS CSCL 01E

As in the case for the rate of descent of an aircraft, frequently the derivative of a state cannot be observed with sufficient accuracy. The state itself can however, but, as with the radar altimeter, the signal is too noisy for differentiation. The approach presented uses the form of the Kalman filter as an observer for the derivatives of the observed signals or states. The gain matrix for the filter is derived to minimize the variance of the estimate of the derivative of the state, instead of the state itself. The derived gain matrix and the covariance of the (derivative) estimation error are related to those of the Kalman filter through the system's dynamics. A quantitative evaluation of this method's improvement over taking the derivative of the optimum filter of the state and/or augmenting the state vector, is included. The improvement over the former is shown to increase linearly with the covariance of the state's estimation error. Over augmenting the state vector, the improvement uses the lower order, observable states more directly through the systems dynamics. Author

N71-30253# Army Test and Evaluation Command, Aberdeen Proving Ground, Md

AIRBORNE TRANSPONDERS, (IFF AND/OR AIR TRAFFIC CONTROL) Final Report

19 Mar 1971 19 p refs

(AD-723028, MTP-6-3-126) Avail NTIS CSCL 17/2

The materiel test procedure describes tests for evaluating airborne transponders operated in conjunction with air traffic control facilities. Tests are conducted by aircraft equipped with the airborne transponder and designated auxiliary equipment, directed and controlled by an air traffic control facility suitably equipped with compatible interrogating equipment and auxiliary equipment. Author (GRA)

N71-30258# Army Test and Evaluation Command, Aberdeen Proving Ground, Md

GROUND SUPPORT SERVICE EQUIPMENT (AVIATION) Final Report

12 Mar 1971 54 p refs

(AD-723036, MTP-7-2-055) Avail NTIS CSCL 1/5

The procedure describes test methodology and testing techniques necessary to determine the technical performance and safety characteristics of ground support service aviation equipment and associated accessories. Author (GRA)

N71-30263*# Scientific Translation Service, Santa Barbara, Calif
SURVEY OF THE EXPERIMENTAL CAPABILITIES OF THE ONERA HYDRODYNAMIC TUNNEL, WHICH OFFERS FLOW VISUALIZATION [APERCU SUR LES POSSIBILITES EXPERIMENTALES DU TUNNEL HYDRODYNAMIQUE A VISUALISATION DE L'ONERA]

H. Werle. Washington: NASA, Jul 1971. 57 p. refs. Translated into ENGLISH of French report ONERA-NT-48.

(Contract NASw-2035)

(NASA-TT-F-13727, ONERA-NT-48) Avail NTIS CSCL 14B

After a review of the conditions in which the ONERA hydrodynamic water-wind tunnel is used, a discussion of its experimental capabilities is presented with several examples of recent research. Author

N71-30264# Imperial Coll. of Science and Technology, London (England)

THE FLOW IN S SHAPED DUCTS

P. Bansod and P. Bradshaw. Apr 1971. 27 p. refs

(IC-71-10) Avail NTIS

Measurements are presented of total pressure, static pressure, surface shear stress, and yaw angle in the flow through several S-shaped ducts, each with a thin turbulent boundary layer at entry. The results show that the region of low total pressure in the exit plane, found by previous workers, is due to a vortex-stretching mechanism which may also appear in other flows. Author

N71-30278*# Remtech, Inc., Birmingham, Ala

A STUDY OF TURBULENCE MEASUREMENTS USING LASER DOPPLER SYSTEM. Interim Report, Jun. 1970-Jun. 1971

C. E. Fuller. 27 May 1971. 75 p. refs

(Contract NAS8-25896)

(NASA-CR-119804, RTR-002-1) Avail NTIS CSCL 20D

The object of the wing tip vortex test is to demonstrate the extent to which the Laser Doppler Velocimeter system can be used for the measurement of gas velocities with high spatial and temporal resolution. This test was planned to provide three dimensional mean velocity data of the vortex pattern shed from a wing tip at an angle of attack. These measurements are being conducted at the MSFC 7 x 7 inch wind tunnel facility. The test plan and procedure as well as the measurements that were made are included. In addition, data on several measurements of the system's operating parameters which are important to these tests are also given. E M C

N71-30282*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
LOW SPEED WIND TUNNEL INVESTIGATION OF A SEMISPAN STOL JET TRANSPORT WING--WITH DEFLECTED THRUST AND BLOWING BOUNDARY LAYER CONTROL

Robert L. Henderson. Washington: NASA, Jul 1971. 87 p. refs

(NASA-TN-D-6256, L-7543) Avail NTIS CSCL 01A

An investigation of the static longitudinal aerodynamic characteristics of a semispan swept wing with an aspect ratio of 3.92 and having deflected thrust and blowing boundary-layer control was performed mainly in a low-speed tunnel with a 3.7-m (12-ft) octagonal test section at the Langley Research Center. Thrust was provided by two pod-mounted ducted fans equipped with 60 degree exhaust deflection vanes, and boundary-layer control was provided by air blowing through a slot over a full-span plan trailing-edge flap. Author

N71-30283*# National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio
**FLIGHT INVESTIGATION OF INSTALLATION EFFECTS
ON A PLUG NOZZLE INSTALLED ON AN UNDERWING
NACELLE**
Nick E. Samanich and Roger Chamberlin Washington Jul 1971
57 p refs
(NASA-TM-X-2295, E-5546) Avail NTIS CSCL 01A

Several variations of plug nozzles were tested using an F-106B aircraft in the Mach range 0.6 to 1.3. These nozzles simulated the subsonic configurations of variable-geometry plug nozzles designed for Mach 2.8 operation. The nozzles were tested with a J85-GE-13 turbojet engine and the data compared to that of 0.34-scale isolated wind tunnel models. For most of the configurations tested, no significant installation effect was measured between Mach 0.8 and 0.9. There was an adverse effect at lower speeds and at Mach numbers from 1.0 to 1.2, and a favorable effect at Mach 0.95. The major differences between the isolated and installed nozzle performance resulted from changes in pressure forces on the plug surface. Author

N71-30301# General Accounting Office, Washington, D.C. Office of Comptroller General
**ADVERSE EFFECTS OF PRODUCING DRONE
ANTISUBMARINE HELICOPTERS BEFORE COMPLETION
OF DEVELOPMENT AND TESTS** Department of the Navy,
B-160877: Report to Congress
Elmer B. Staats 31 Dec 1970 51 p refs
Avail NTIS

The problems encountered in operational deployment of the QH-50 drone helicopter by the U.S. Navy are discussed. The causes for the excessive loss rate are examined and corrective actions are recommended. The primary cause for failure is reported to be the result of procuring the helicopter before completion of development and flight test. Author

N71-30315# Grumman Aerospace Corp., Bethpage, N.Y. System Sciences Section
**A STATISTICAL ANALYSIS OF THE A-6A INERTIAL
NAVIGATION SYSTEM**
R. Gran Jun 1971 21 p refs
(RM-511) Avail NTIS

A statistical analysis of the gyro-compass mode of the A-6A inertial navigation system was performed. The inertial system is assumed to have various stochastic perturbations caused by gyroscope drifts, accelerometer drift, and a white measurement noise from the ship inertial navigation system (SINS). The result of the analysis is the variance in the estimate of the gyroscopic drift due to the assumed stochastic processes. The analysis of the system as provided by the ground support department showed that the system was unstable as it stood. A change in one of the feedback gains was made so as to stabilize the gyro-compass loop. Then, an analysis of the resulting loop showed a maximum error of 9.9 deg/hr due to all of the assumed noises. Author

N71-30321# Technische Hogeschool, Delft (Netherlands)
Vliegtuigbouwkunde
**A UNIFIED THEORY FOR LINEARIZED SHOCK-ON-SHOCK
INTERACTION PROBLEMS**
N. L. Arora Dec 1969 165 p refs
(VTH-158) Avail NTIS

A systematic and unified theory is deduced for the non-uniform flow field produced behind a plane shock of arbitrary strength

when it encounters an aerodynamic obstacle moving at supersonic speed. The obstacle has a weak attached shock and a collision between the two shocks occurs. This is known as shock-shock interaction. The obstacles considered are airfoils, antisymmetric slender bodies, and three dimensional wings. ESRO

N71-30324# Office National d'Etudes et de Recherches
Aerospaciales, Paris (France)
**A LINEAR CONTROL OF SYSTEMS WITH RANDOM INPUT:
APPLICATION TO GUST RESPONSE CONTROL [SUR LE
CONTROLE LINEAIRE D'UN SYSTEME SOUMIS A UNE
EXCITATION ALEATOIRE. APPLICATION A LA TENUE D'UN
AVION EN ATMOSPHERE TURBULENTE]**
Jacqueline Boujot (Ph.D. Thesis—Paris Univ.) 1970 68 p refs
In FRENCH, ENGLISH summary
(ONERA-Publ-131) Avail NTIS

A general optimization problem giving a standard linear expression of control is applied to complex, actual systems such as aircraft flying in turbulence. The first part is devoted to the axiomatic definition of physical linear systems from a functional point of view. With the help of optimal control theory, which gives a closed form expression in special cases, the problem is solved in a more general way in the normed space previously defined. An expansion of the solution is deduced. The analysis of gust response properties of a structure in flight yields the formulation and the solution for the optimal gust response control of an aircraft. By applying this method it is possible to design gust response control devices whose properties and qualities are discussed from a technical point of view. Author (ESRO)

N71-30325# Deutsche Forschungs- und Versuchsanstalt fuer
Luft- und Raumfahrt, Porz (West Germany) Inst fuer Angewandte
Gasdynamik
**SOME EXPERIMENTAL INVESTIGATIONS ON THE
MULTIPLE-BODY-PROBLEM IN SUPERSONIC FLOW
[EINIGE EXPERIMENTELLE UNTERSUCHUNGEN ZUM
MEHRKOERPERPROBLEM BEI UEBERSCHALLSTROMUNG]**
Friedrich Keune, Hansgeorg Riedel, and Hans Emunds 1971
88 p refs In GERMAN, ENGLISH summary
(DLR-FB-71-04) Avail NTIS, DFVLR Porz 28.80 DM

The most important aerodynamic coefficients of bodies having comparable volumes and which form so-called multiple-body-systems, have been determined in the 60 x 60 sq cm supersonic wind tunnel of the DFVLR for the Mach number range from 1.56 to 4.02. Of particular interest were the differences in drag arising from possible changes in the arrangement of the body system. Differences of the order of from 10% to 20% were obtained. The gain of a markedly lower drag entails no unfavorable other aerodynamic properties. Author (ESRO)

N71-30350*# Scientific Translation Service, Santa Barbara, Calif
BASIC STUDY OF THE AFTERBURNER
Yoshiyuki Ohya Washington NASA Jul 1971 44 p refs
Transl. into ENGLISH from Ishikawajima Harima Tech Rept (Japan),
v. 10, no. 3, May 1970 p. 229-242
(Contract NASw-2035)
(NASA-TT-F-13657) Avail NTIS CSCL 21E

Afterburning in turbine engines, especially fan engines, has been used as an optimum means to produce both supersonic and subsonic performance of military and commercial aircraft, and is especially indispensable for supersonic flight. The major problem in

the fan burner is flame stabilization at low inlet temperatures. Flame stabilizing devices, with various configurations, have been tested at atmospheric inlet conditions. It was found that V-gutter flame holders, with injection of small amount of fuels into the flame holder wake, bring about broadening of the combustible zone of air/fuel ratio. Author

N71-30361# Joint Publications Research Service, Washington D C

HOLOGRAPHY AND ITS APPLICATION IN AVIATION AND COSMONAUTICS

V Frolov and Yu Soluyanov 22 Jun 1971 8 p Transl into ENGLISH from Aviaty i Kosmonavt (Moscow) No 4 1971 p 44 45

(JPRS-53420) Avail NTIS

The principles of holography are briefly outlined and possible applications of light beams in three dimensional imagery for aviation and space flight are discussed. Considered are aerial holographic photography, saturation air space mapping for flight control, terrain relief mapping, holographic indicators for blind landing systems, holographic flow visualization methods, and holographic detection of camouflaged objects. G G

N71-30488# Massachusetts Univ., Amherst Dept of Mechanical and Aerospace Engineering

THE CALCULATION OF THE PRESSURE DISTRIBUTION ON A CASCADE OF THICK AIRFOILS BY MEANS OF FREDHOLM INTEGRAL EQUATIONS OF THE SECOND KIND

E Martensen Washington NASA Jul 1971 59 p refs Transl into ENGLISH of the publ 'Die Berechnung der Druckverteilung an Dicken Gitterprofilen mit Hilfe von Fredholmschen Integralgleichungen Zweiter Art' Goettingen, Max-Planck-Inst fuer Stroemungsforschung und der Aerodyn Versuchsanstalt, 1959 Sponsored by NASA

(NASA-TT-F-702, Rept-23) Avail NTIS CSCL 01A

Two independent linear integral equations of the second kind with continuous kernels are derived for the exact potential theory for the velocity distribution on a cascade of thick airfoils. It is shown that the corresponding homogeneous integral equations possess one and only one nontrivial solution, so that one knows the general results on the basis of the Fredholm theorems. In the limiting case of infinite separation between airfoils the equations reduce to the familiar expressions for single airfoils. In the light of the periodicity properties which are present, one may develop a numerical calculation technique based on the solution from a system of linear equations. By selecting an adequately large number of unknowns, the desired accuracy is obtained. Examples are shown correlating the theory with an exact known solution and with measurements. Author

N71-30506# National Aeronautics and Space Administration, Washington, D C

JOINT DOT-NASA CIVIL AVIATION RESEARCH AND DEVELOPMENT POLICY STUDY: REPORT

Mar 1971 104 p refs Prepared in cooperation with Dept of Transportation

(NASA-SP-265, DOT-TST-10-4) Avail NTIS CSCL 01B

Analyses of such varied subjects as long- and short-haul passenger service, air cargo, general aviation, air vehicles, air traffic control, airports, complementary surface transportation, financial considerations, institutional and environmental factors, foreign competition, military contributions to civil aviation benefits, and several key policy issues are presented. Author

N71-30507# National Aeronautics and Space Administration, Washington, D C

JOINT DOT-NASA CIVIL AVIATION RESEARCH AND DEVELOPMENT POLICY STUDY: SUPPORTING PAPERS

Mar 1971 248 p refs Prepared in cooperation with Dept of Transportation

(NASA-SP-266, DOT-TSY-10-5) Avail NTIS CSCL 01B

A variety of subjects, some technical- which relate directly to civil aviation research and development - and some nontechnical which affect the climate for technical innovation in the civil aviation industry and therefore determine whether the results of research and development will find application in the future are discussed. The specific missions performed by civil aviation and the four system elements of each of these missions are presented. Each technical section is based on analyses of the characteristics and growth to date, current problems, future requirements (demand for service), potential solutions, implication for R&D, and recommendations. Author

N71-30530# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va

EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF SUBSONIC LONGITUDINAL AND LATERAL AERODYNAMIC CHARACTERISTICS OF SLENDER SHARP EDGE 74 DEG SWEEP WINGS

Edwin E Davenport and Jarrett K Huffman Washington Jul 1971 48 p refs

(NASA-TN-D-6344, L-7599) Avail NTIS CSCL 01A

Slender sharp-edge wings having leading-edge sweep angles of 74 deg were studied at Mach numbers from 0.2 to 0.8. The wings had arrow, delta, and diamond planforms and were tested at angles of attack from -4 deg to 30 deg and angles of sideslip from -8 deg to 8 deg. The study consisted of wind-tunnel tests in the Langley high-speed 7- by 10-foot tunnel. Author

N71-30656# Techtran Corp., Glen Burnie, Md

DETERMINATION OF THE AERODYNAMIC CHARACTERISTICS OF AN ELASTIC SWEEP WING IN SUBSONIC FLOW [OPREDELENIYE AERODINAMICHESKIKH KHKARAKTERISTIK UPRUGOGO STRELOVIDNOGO KRYLA V DOZVUKOVOM POTOKE]

A Kh Karimov Washington NASA Jul 1971 15 p refs Transl into ENGLISH from Izv Vysshikh Uchebn Zavedenii, Aviaty Tekhn (USSR), v 13, no 3, 1970 p 5-13

(Contract NASw-2037)

(NASA-TT-F-13717) Avail NTIS CSCL 01A

The aerodynamic forces are calculated and the equations derived for an elastic wing of an aircraft in steady subsonic flow with a given overload, weight, and dynamic head. The calculations are made by a method, which is not only more accurate than the lifting line and lifting zone theories, and the sequential approximation method, but also provides for determination of the pressure centers for arbitrary wing deformations in addition to the lift. It is also more convenient than the sequential approximation in that it obviates the necessity of computing the deformation-produced forces at each stage of the calculation, as well as the need to apply special measures to improve the convergence of the sequential approximation process. Author

N71-30669# General Electric Co., Cincinnati, Ohio

INVESTIGATION OF A HIGHLY LOADED MULTISTAGE FAN DRIVEN TURBINE

D C Evans Washington NASA Jul 1971 34 p

(Contract NAS3-14304)

(NASA-CR-1862) Avail NTIS CSCL 20D

The results of a vector diagram study are presented. The effect of flowpath configuration, stage leaving swirl, work gradients, nonconstant work, stage energy split, and streamline slope and curvature were investigated. Based on these studies a particular type of vector diagram calculation was selected for the turbine design.

Author

N71-30675# Laboratorium fuer Betriebsfestigkeit, Darmstadt (West Germany)

INDIVIDUAL FLIGHT PROGRAM TESTS OF NOTCHED CANTILEVER BEAMS FOR PRELIMINARY DESIGN OF WING ATTACHMENT OF VFW 614 [EINZELFLUGVERSUCHE AN KERBSTAESEN ZUR VORDIMENSIONIERUNG DES FLUEGELWURZELBEREICHES DER VFW 614]

D Schuetz 1970 22 p refs. In GERMAN, ENGLISH summary. Sponsored by Ver Flugtech Werke (TB-89) Avail NTIS

A flat plate cut from sheet metal was subjected to load programs on a testing machine, thus simulating in-flight stress on wing root structural members. The load program and the actual testing are described. ESRO

N71-30718*# National Aeronautics and Space Administration Flight Research Center, Edwards, Calif

EVALUATION OF EFFECTS OF HIGH-ALTITUDE TURBULENCE ENCOUNTERS ON THE XB-70 AIRPLANE

Ronald J Wilson, Betty J Love, and Richard R Larson. Washington Jul 1971 85 p refs. (NASA-TN-D-6457, H-631) Avail NTIS CSCL 01B

A turbulence response investigation was conducted with the XB-70 airplane. No special turbulence penetration techniques, speeds, or other restrictions were specified for the investigation, nor were any flights made solely to obtain turbulence data. During 79 flights, turbulence was encountered, and recorded on a VGH recorder, 6.2 percent of the total flight distance at supersonic speeds above an altitude of 12,192 meters (40,000 feet). Geographical locations are given for selected turbulence encounters. For 22 flights the airplane was instrumented to measure true gust velocities and the structural acceleration response to turbulence. The turbulence intensities measured were very low in comparison with those measured at high altitudes in other investigations. Acceleration response spectra, frequency response transfer functions, and coherence functions 0.88, 1.59, and 2.35. Results are compared with calculated studies. Frequencies from the vertical and lateral structural modes, dominant in the airplane acceleration responses, were compared with the natural frequencies of the human body in the vertical and lateral directions. Author

N71-30741*# Tennessee Technological Univ., Cookeville

AN OPTIMAL CONTROLLER BASED ON LINEAR APPROXIMATION OF AN ACOUSTICAL TEST FACILITY, PART B Final Report

Dennis L Luckinbill and Allen R Atkins, II Jun 1971 91 p refs. (Contract NAS9-10385) (NASA-CR-115073) Avail NTIS CSCL 14B

The possibility of using a more sophisticated control algorithm such as one derived from the deadbeat response criterion, instead of a direct controller is studied. The control algorithm is based on a second order approximation of the entire test facility. The algorithm was tested and proved with the aid of digital simulation runs on an IBM 360-40 computer. The most important area of

work is the digital controller study, and the minor area of work is modelling of the major dynamic components of the physical test facility. Author

N71-30747# Imperial Coll of Science and Technology, London (England) Dept of Aeronautics

TURBULENT BOUNDARY LAYER STUDIES IN A HYPERSONIC GUN TUNNEL

G M Elfstrom, G T Coleman, and J L Stollery Apr 1971 18 p refs. (IC/71/11) Avail NTIS

A hypersonic gun tunnel has been used to study the growth of a turbulent boundary layer over flat plate and compression corner models. Measurements include pressure and heat transfer rate distributions and pitot pressure profiles across the boundary layer. The results, which extend the existing range of data, are used to test some current theoretical predictions. Author

N71-30748*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va

AERODYNAMIC AND DEPLOYMENT CHARACTERISTICS OF MULTISTAGE CANOPY AND SUSPENSION-LINE REEFING SYSTEMS FOR A TWIN-KEEL ALL-FLEXIBLE PARAWING

Harry L Morgan, Jr and Austin D McHatton Washington Jul 1971 60 p refs. (NASA-TN-D-6306, L-7567) Avail NTIS CSCL 01B

An investigation was conducted to determine the aerodynamic and deployment characteristics of a twin-keel all-flexible parawing rigged with several variations of a multistage canopy and suspension-line reefing system. Each variation consisted of four stages of suspension-line reefing with or without some form of canopy reefing during the first stage. A theoretical analysis was made initially to determine design values for the resultant-force coefficient and the lift-drag ratio which would prevent the peak deployment load from exceeding a 3g design limit during each stage of the deployment sequence. Experimental aerodynamic data were obtained from wind-tunnel tests of 9.29 sq m (100 sq ft) wings rigged with various amounts of canopy and suspension-line reefing. Several reefing systems were then selected which had experimental values for the resultant-force coefficient and the lift-drag ratio as close as possible to the design values for each stage. Several 37.16-sq m (400-sq ft) wings were rigged with the selected reefing systems and flight-tested to determine their deployment characteristics. The results of the wind-tunnel and flight tests are presented, and detailed descriptions of the canopy and suspension-line reefing techniques, the wind-tunnel tests, and the method used to calculate the theoretical time-history of the deployment load are included as appendices. Author

N71-30756*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va

NASA AIRCRAFT SAFETY AND OPERATING PROBLEMS, VOLUME 1 Conference Proceedings

Washington 1971 444 p refs. Conf held at Langley Sta., Va., 4-6 May 1971. (NASA-SP-270) Avail NTIS HC\$6.00/MF\$0.95 CSCL 01B

Conference papers are presented on flight safety, airway and runway environments, subsonic cruise aircraft, cockpit environment, terminal area operations, flight environment, and induced environmental effects.

N71-30757*# National Aeronautics and Space Administration
Langley Research Center, Langley Station, Va

FACTORS AFFECTING DITCHING OF NEW TRANSPORT AIRPLANES

Lloyd J. Fisher *In its* NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 1-10

Avail NTIS HC\$6 00/MF\$0 95 CSCL 01B

Investigations of aircraft ditchings using dynamic models of the C-5 aircraft are discussed. The behavior of the model with wheels up or down, and the fuselage damage during ditching are described. The major factors affecting ditching are considered to be bottom damage, landing attitude, flap setting, gear position, wave heading, floor strength, and wing location. It is concluded that ditching safety can be increased by designing suitable floor structures and by wing location. F O S

N71-30758*# National Aeronautics and Space Administration
Ames Research Center, Moffett Field, Calif

STUDY OF PROTECTION OF PASSENGERS IN AIRCRAFT CRASH FIRES

Carr B. Neel and Richard H. Fish *In its* NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 11-31 refs

Avail NTIS HC\$6 00/MF\$0 95 CSCL 01B

A method for surrounding the passenger compartment with a fire-retardant shell was studied to protect the occupants long enough for a fire to burn out, or for fire fighting equipment to extinguish the fire. A lightweight foam plastic called polyisocyanurate foam, and an intumescent paint which expands to many times its original thickness was tested using an aircraft fuselage in a jet-fuel fire. The tests showed that in the protected portion of the cabin, the air temperature changed very little for the first six minutes, when the heat penetrated, the temperature rose to 150 C in 12 minutes. It is concluded that problems such as protecting the fuselage against rupture, and providing protection for windows must be solved before this type system can be used for passenger protection. F O S

N71-30759*# National Aeronautics and Space Administration
Manned Spacecraft Center, Houston, Tex

IMPROVEMENT OF FIRE SAFETY IN AIRCRAFT

Mathew I. Radnoffsky *In its* NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 33-47

Avail NTIS HC\$6 00/MF\$0 95 CSCL 01B

Nonflammable and fire-resistant materials used within spacecraft were evaluated for applicability to commercial aircraft refurbishment. Durability and esthetic qualities of fibrous, cellulosic, elastomeric, and composite materials were considered for commercial aircraft items including curtains, upholstery, carpets, decorative panels, cabinets, paper products, oxygen lines, and straps. Two T-39 and one NASA Gulfstream aircraft refurbishment programs applying the technological advances are outlined. J M

N71-30760*# National Aeronautics and Space Administration
Langley Research Center, Langley Station, Va

A CONTINUOUS WAVE DOPPLER SYSTEM FOR AIRCRAFT COLLISION HAZARD WARNING

Richard H. Couch and Charles L. Britt (Res. Triangle Inst.) *In its* NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 49-59

Avail NTIS HC\$6 00/MF\$0 95 CSCL 01B

A low-cost pilot warning indicator (PWI) suitable for use in commercial and general aviation is being developed for warning

pilots of an impending midair collision hazard. General studies were conducted to compare alarm performance of various ideal systems having different warning criteria. From the studies, it was determined that the required measurements were relative range, closing velocity, and altitude difference. The PWI consists of a transceiver and display unit onboard the protected aircraft and a linear transponder on the intruding aircraft. It is concluded that the system has the capability of handling a large number of aircraft without saturation. F O S

N71-30761*# National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio

LIGHTNING INDUCED VOLTAGES IN AIRCRAFT ELECTRICAL CIRCUITS

Paul T. Hacker *In its* NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 61-73 refs

Avail NTIS HC\$6 00/MF\$0 95 CSCL 01B

A study was conducted to determine the magnitude of induced voltages and their relation to the characteristics of the lightning discharge and to the physical and electrical characteristics of the aircraft and its electrical systems. The investigation was performed with a wing of an F-89 airplane and a simulated lightning facility. The induced voltages measured for some circuits and simulated lightning characteristics were of sufficient magnitude to adversely affect sensitive avionics. Author

N71-30762*# National Aeronautics and Space Administration
Lewis Research Flight Center, Cleveland, Ohio

STATUS OF ENGINE ROTOR BURST PROTECTION PROGRAM FOR AIRCRAFT

Patrick T. Chiarito *In its* NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 75-88 refs

Avail NTIS HC\$6 00/MF\$0 95 CSCL 01B

The status of the experimental research program to develop criteria for the design of devices to protect aircraft from rotor fragments is presented. Test rotors were intentionally failed and generated fragments which impacted containment/deflection devices. High-speed photographs recorded the complex interactions for subsequent analysis. Test results indicate that the capability of a ring to contain rotor fragments depends upon the number of fragments as well as the mechanical properties of the structural material. Both metals and nonmetals show good potential. It was demonstrated that partial rings can deflect fragments away from areas to be protected. A computer program was developed which predicts the ring deformation if the forces applied by the fragments are known. Another program uses measured ring deflections to calculate the applied forces. These forces are subsequently used to calculate ring deflections. Predicted and measured ring profiles are in reasonable agreement for single-rotor-blade impacts of freely supported rings. Author

N71-30763*# National Aeronautics and Space Administration
Marshall Space Flight Center, Huntsville, Ala

CLEAR-AIR-TURBULENCE DETECTION USING LASERS

Edwin A. Weaver *In its* NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 89-100 refs

Avail NTIS HC\$6 00/MF\$0 95 CSCL 01B

The feasibility of detecting clear-air turbulence (CAT) was investigated using a CO₂ laser Doppler system. The detection of aerosols in regions of CAT by a ground-based ruby laser, the laser Doppler principle, and the airborne CO₂ laser Doppler system are discussed. It is concluded that CAT detection and measurement appear feasible with a CO₂ pulsed laser Doppler system. F O S

N71-30764*# National Aeronautics and Space Administration
Langley Research Center, Langley Station, Va
PROGRESS REPORT ON WING-TRAILING-VORTEX STUDIES

R Earl Dunham, Jr., Harry A Verstynen, Jr., and Margaret S Benner *In its* NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 101-113 refs

Avail NTIS HC\$6 00/MF\$0 95 CSCL01A

The effect of wing-tip vortex wakes generated by large jet transport aircraft on smaller airplanes was investigated by determining the wake location relative to the generating aircraft and the strength of the vortex at points along the wake trail. The generating aircraft were a B-52, C-5A, DC-9, and a Convair 990. The gross weight varied from 78,000 lb to 600,000 lb, and the airplanes were flown in either clean, or landing approach configurations. The results indicate (1) At holding or landing-approach speeds, the average vertical downwash path of the vortex can extend 750 ft to 1000 ft below the flight level of the generating airplane, at a range of 10 n mi (2) The wake strength and dissipation are predominately influenced by the generating-airplane weight and configuration (3) The strongest wake turbulence was noted when the generating airplane was in the clean configuration (4) The resulting upsets experienced by smaller airplanes indicate a need for a more conservative airway spacing criteria F O S

N71-30765*# National Aeronautics and Space Administration
Flight Research Center, Edwards, Calif
AIRCRAFT RESPONSE TO THE WING TRAILING VORTICES GENERATED BY LARGE JET TRANSPORTS

William H Andrews, Glenn H Robinson, and Richard R Larson *In its* NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 115-126 refs

Avail NTIS HC\$6 00/MF\$0 95 CSCL01B

A flight-test program to evaluate the effect of the wing-tip vortex wake generated by large jet transport airplanes on a variety of smaller airplanes is reported. The resulting flight investigation was designed to obtain data essential to the determination of the wing-wake location relative to the generating aircraft and the apparent strength and dissipation of the vortex at a specified point along the wake trail. An additional objective of the investigation was to evaluate the upset potential and subsequent recovery capability of a variety of airplanes penetrating the vortex system.

Author

N71-30766*# National Aeronautics and Space Administration
Langley Research Center, Langley Station, Va
STATUS OF RESEARCH ON RUNWAY ROUGHNESS

Albert W Hall, Paul A Hunter, and Garland J Morris *In its* NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 127-142 refs

Avail NTIS HC\$6 00/MF\$0 95 CSCL01E

Current NASA research on runway surface roughness is described. Typical data available from several programs are illustrated and discussed. The programs emphasize two areas defining roughness by measuring runway and taxiway profiles and by measuring airplane response to roughness.

Author

N71-30767*# National Aeronautics and Space Administration
Langley Research Center, Langley Station, Va
RUNWAY SLIPPERINESS

Walter B Horne *In its* NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 143-152 ref

Avail NTIS HC\$6 00/MF\$0 95 CSCL01E

The effects of runway contaminants and pavement surface properties on runway slipperiness are discussed. Results show that contaminants such as water, slush, snow, ice, dust, oil, and rubber deposits on conventional pavement surfaces can produce intolerable levels of runway slipperiness in terms of safe aircraft operation. When wet, conventional surfaces vary considerably in slipperiness due to pavement surface microtexture and macrotexture. A more consistent safe level of slipperiness appears achievable with new surface treatment techniques such as runway grooving and porous asphalt overlays.

E H W

N71-30768*# National Aeronautics and Space Administration
Langley Research Center, Langley Station, Va
EFFECTS OF AIRPLANE OPERATIONS ON TIRE WEAR

John L. McCarty and Upshur T. Joyner *In its* NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 153-163

Avail NTIS HC\$6 00/MF\$0 95 CSCL01B

Tire wear studies were undertaken to explore chevron cutting damage resulting from airplane touchdown on grooved runways and to examine the wear attributed to airplane braking operations. Preliminary results show chevron cutting occurs at the spot on the tire which initially contacts the surface and the damage is the result of the scrubbing action of the tire as it skids over the grooves prior to any rotation. The cutting is shown to occur only in large tires requiring a large force to induce rotation. Results also indicate that the cutting is essentially independent of grooving patterns on runways but strongly dependent upon the nature of the surface finish. It was shown that tire tread pattern and/or rubber composition also affect the extent of cutting. Tire measurements made during braking indicate the economic advantage of an airplane brake control system capable of limiting the wheel slip ratio. It was suggested that tire wear is unaffected by runway grooving.

Author

N71-30769*# National Aeronautics and Space Administration
Langley Research Center, Langley Station, Va
APPLICATION OF ADVANCED AERODYNAMICS TO FUTURE TRANSPORT AIRCRAFT

Albert L Braslow and Theodore G Ayers *In its* NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 165-176

Avail NTIS HC\$6 00/MF\$0 95 CSCL01A

An attempt is made to apply supercritical airfoils to transport aircraft. Flight tests were conducted using the F-8 aircraft. The tests were conducted to determine maneuverability, speed margins, off-design performance, problems associated with high lift and lateral control devices, and the sensitivity of the wing to contour variations associated with manufacturing processes and deformations of the wing under flight loads.

E H W

N71-30770*# National Aeronautics and Space Administration
Langley Research Center, Langley Station, Va
FLIGHT EVALUATION OF A DISPLAY FOR STEEP APPROACH

R Earl Dunham, Jr., Jack J Hatfield, Henry C Elkins, and Richard H Sawyer *In its* NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 177-187 refs

Avail NTIS HC\$6 00/MF\$0 95 CSCL01B

Results from an investigation of a display concept designed to alleviate the problems of inadequate guidance and display information for making steep approaches, are given. The 6 degree/3 degree two segment glide slope and commercial military, research, and Lear jet aircraft were used in the investigations. Conclusions

indicate the vertical situation display concept shows promise. The concept also shows better flight and airspeed control and power management than with a conventional cross painter indicator. The improved guidance and situation information provided by the display system allows more freedom in flight path management and cuts down on the work function. E H W

N71-30771*# National Aeronautics and Space Administration
Flight Research Center, Edwards, Calif

HANDLING QUALITIES OF LIGHT AIRCRAFT WITH ADVANCED CONTROL SYSTEMS AND DISPLAYS

Paul C Loschke, Marvin R Barber, Calvin R Jarvis, and Einar K Enevoldson. In *its* NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 189-206 refs

Avail NTIS HC\$6.00/MF\$0.95 CSCL01B

Flight tests to determine the benefits of advanced control systems and displays on the handling qualities of general aviation aircraft, primarily during ILS (Instrument landing system) approaches in turbulence, have shown that very significant benefits can be achieved. The use of a flight director display and an attitude command control system in combination was shown to transform a typical light aircraft into a flying machine that borders on being perfect from a handling qualities standpoint during ILS approaches in turbulent air. The singular use of either the flight director display or the attitude-command control system provided significant benefits. A rate command control system was found to provide significantly less benefit than an attitude command control system. The command control systems tested tended to improve the poststall response of the basic aircraft, but degraded its stall warning characteristics. The control systems improved the response of the aircraft to sudden engine failures. Author

N71-30772*# National Aeronautics and Space Administration
Ames Research Center, Moffett Field, Calif

THE INFLUENCE OF MOTION ON THE EFFECTIVENESS OF FLIGHT SIMULATORS IN TRAINING MANEUVERS

Richard S Bray, Fred J Drinkwater, III, and Emmett B Fry. In *its* NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 207-220 refs

Avail NTIS HC\$6.00/MF\$0.95 CSCL 14B

The use of a new research flight simulator has demonstrated the value of lateral motion cues in the simulation of maneuvers required in the training of air transport pilots. The availability of very extensive lateral motion has provided the opportunity to form a tentative definition of the minimum lateral motion required to produce the desired simulation fidelity. The less extensive vertical motion capabilities of the simulator provided useful cues but did not markedly reduce the long standing problem of accurately simulating the flare and touchdown portion of the landing maneuver. The overall effectiveness of the simulator in takeoff and landing maneuvers involving lateral directional control problems suggests that the scope of simulator training tasks can be expanded beyond those currently performed in flight and simulators. Author

N71-30773*# National Aeronautics and Space Administration
Ames Research Center, Moffett Field, Calif

SAFETY CONSIDERATIONS AND POWERED-LIFT STOL AIRCRAFT

Curt A Holzhauser and Robert C Innis. In *its* NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 221-231 refs

Avail NTIS HC\$6.00/MF\$0.95 CSCL01B

Methods for developing powered lift in commercial STOL aircraft are given. To use powered lift it is necessary that airworthiness

conditions account for the propulsion system contribution to lift and control. Changes are needed for these conditions to assess the consequences of propulsion system failures during the approach mode. E H W

N71-30774*# National Aeronautics and Space Administration
Langley Research Center, Langley Station, Va

OPERATIONAL ASPECTS OF V/STOL INSTRUMENT APPROACHES

Lee H Pearson, Jr., Samuel A Morello, Curt A Holzhauser (NASA Ames Res Center), and Ronald M Gerdes (NASA Ames Res Center). In *its* NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 233-247 refs

Avail NTIS HC\$6.00/MF\$0.95 CSCL01B

Terminal area studies using various V/STOL configurations were made to develop an operational technique for managing powered lift during simulated precision approaches from cruise to landing. The results of these studies are integrated into a realistic appraisal of V/STOL instrument approach techniques. The configurations evaluated are discussed including the powered-lift concepts they represent and the powered-lift controls available to the pilot. The mechanics of a generalized powered-lift concept relative to an approach glide path are investigated and the operational aspects of powered lift are discussed with regard to stabilization requirements, conversion maneuver, glide-path control, and velocity control or deceleration schedule on the approach. The four aircraft studied include the Kestrel (a vectored jet), the XV-5B (a fan in wing), the XC-142A (a tiltwing), and the Do-31 (a mixed-propulsion jet), and represent fundamentally different V/STOL concepts. A brief description of the powered-lift system in each aircraft and the controls available to the pilot for managing the systems is presented. Author

N71-30775*# National Aeronautics and Space Administration
Langley Research Center, Langley Station, Va

ANALYSIS OF SOME HELICOPTER OPERATING PROBLEMS

Charles E K Morris, Jr., John F Ward, Julian L Jenkins, Jr., and William J Snyder. In *its* NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 249-261 refs

Avail NTIS HC\$6.00/MF\$0.95 CSCL01B

Results of analyses and experimental studies of some helicopter operating conditions are outlined. Low-speed directional-control limitations, rotor oscillatory loads in maneuvers, maneuver lift sharing of compound helicopters, and fuselage vibration and passive isolation problems are discussed along with possible solutions. J M

N71-30776*# Virginia Univ., Charlottesville
SOME ASPECTS OF THE AERODYNAMICS OF STOL PORTS

Herman M Parker, Jeffrey N Blanton, and Kalman J Grunwald (NASA Langley Res Center). In *its* NASA Langley Res Center NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 263-276

Avail NTIS HC\$6.00/MF\$0.95 CSCL01E

Some aspects of elevated-STOL-port aerodynamics are considered. Two problems of concern are crosswinds and building-induced flow fields. The steady crosswind velocity profile in the landing region, flow separation, vortex shedding, or other unsteady flow phenomena which may contribute significantly to the hazards of landing an STOL craft are discussed. A possible approach to the solution of the crosswind and building-induced-flow-field problems through modifications to the elevated-STOL-port building is presented. Some quantitative measurements of dynamic pressure

were made, but most of the observations were qualitative flow visualizations - smoke and tuft. The effect of fence structure and geometry on changes in crosswind velocity profiles was investigated.
Author

N71-30777*# National Aeronautics and Space Administration
Ames Research Center, Moffett Field, Calif
SIMULATION STUDIES FOR DEVELOPMENT OF CERTIFICATION CRITERIA APPLICABLE TO SST TAKEOFF
C Thomas Snyder, Richard S Bray, Fred J Drinkwater, III, and Raymond D Forrest (FAA) *In its* NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 277-290 refs
Avail NTIS HC\$6 00/MF\$0 95 CSCL 01B

A variety of airplane configurations were utilized in the test program. Nearly 2000 take-offs and 800 landings were made. Engine failure take-off testing of high-induced-drag SST designs confirmed the need for more stringent take-off-speed requirements. However, these tests demonstrated that proposed requirements intended to provide the additional protection, were overconservative and economically penalizing. New minimum requirements were defined and agreed upon during joint testing by British, French, and U S airworthiness authorities. During surprise refused take-offs, the sequence of application of deceleration devices (throttles, brakes, and spoilers) was found to differ from that commonly assumed in the certification process of determining the accelerate-stop distance and has the effect of increasing the stopping distance. The effects of this difference could be amplified for SST airplanes. E M C

N71-30778*# National Aeronautics and Space Administration
Ames Research Center, Moffett Field, Calif
DEVELOPMENT OF TURBULENCE AND WIND SHEAR MODELS FOR SIMULATOR APPLICATION
Richard L Kurkowski, George H Fichtl (NASA Marshall Space Flight Center), and Joseph Gera (NASA Langley Res Center) *In its* NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 291-306 refs
Avail NTIS HC\$6 00/MF\$0 95 CSCL 14B

Information on continuing studies aimed at producing realistic models of turbulence and wind shears for handling qualities studies is presented. An evaluation of analytical models of turbulence which have non-Gaussian gust distributions, a statistical analysis of wind shear, and a brief evaluation of the effects of wind shear on aircraft operations are included.
Author

N71-30779*# National Aeronautics and Space Administration
Langley Research Center, Langley Station, Va
RADIATION SAFETY IN HIGH-ALTITUDE AIRPLANE TRAFFIC
Trutz Foelsche *In its* NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 307-321 refs
Avail NTIS HC\$6 00/MF\$0 95 CSCL 01B

A brief survey of results up to 1970 of an experimental and theoretical study of biologically important radiation components and dose equivalents due to galactic and solar cosmic rays in the high atmosphere, especially at supersonic transport (SST) altitudes, is presented. The dose equivalent rate for the flight personnel flying 500 hours per year at cruise altitudes of 18.2 to 19.8 km (60,000 to 65,000 ft) in high magnetic latitudes turned out to be about 0.75 to 1.0 rem/yr averaged over the solar cycle. This rate is about 15 to 20 percent of the maximum permissible dose (MPD) rate for radiation workers (5 rem/yr), as established by the International Commission on Radiological Protection (ICRP) for peacetime operations. The suggested evasion measure of descending

to lower altitudes is therefore sufficient to avoid overexposure of passengers in such rare cases. Proposed systems of inflight radiation warning and monitoring are briefly discussed.
Author

N71-30780*# National Aeronautics and Space Administration
Langley Research Center, Langley Station, Va
PRELIMINARY STUDY OF AIRPLANE-AUTOPILOT RESPONSE TO ATMOSPHERIC TURBULENCE
Waldo I Oehman *In its* NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 323-334
Avail NTIS HC\$6 00/MF\$0 95 CSCL 01B

A preliminary study was made to determine how the response of a particular airplane to atmospheric turbulence would be affected by automatic controls operating in altitude-hold and attitude-hold modes. The calculations show that excursions of the response variables from their equilibrium values may be reduced by these relatively simple controls. The calculations also show that excursions in the augmented airplane altitude and normal acceleration, caused by response to atmospheric turbulence, may lead to buffeting and passenger discomfort. In order to obtain the most desirable response, the control systems should be more complex than those considered.
Author

N71-30781*# National Aeronautics and Space Administration
Langley Research Center, Langley Station, Va
PRELIMINARY STUDY OF EFFECT OF VIBRATION ON AIRCRAFT RIDE QUALITY
Sherman A Clevenson, William J Snyder, and John J Catherines *In its* NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 335-345
Avail NTIS HC\$6 00/MF\$0 95 CSCL 01B

Difficulty in developing aircraft ride criteria and/or acceptable vibration levels and problems in measuring and recording the relatively low-level vibration environment associated with passenger vehicles in the low-frequency (0 to 30 Hz) regime are considered. The portable, self-contained measuring/recording system used for this low-frequency range is described. In addition, examples of real-time data, peak accelerations, and statistical vibration results are given. The results of controlling the environmental input to a helicopter pilot are also shown.
Author

N71-30782*# National Aeronautics and Space Administration
Langley Research Center, Langley Station, Va
PROGRESS REPORT ON THE NASA V-G/VGH GENERAL AVIATION PROGRAM
Joseph W Jewel, Jr *In its* NASA Aircraft Safety and Operating Probl., Vol 1 1971 p 347-390 refs
Avail NTIS HC\$6 00/MF\$0 95 CSCL 01B

An analysis is presented of 79,000 hours of data obtained from NASA V-G and VGH flight recorders installed on 134 general aviation aircraft engaged in eight types of operations. Information is presented on typical mission characteristics, on airspeed practices, on gust accelerations and derived gust velocities encountered, on maneuver-acceleration experience, and on the initial positive landing-impact accelerations. Comparisons are also made of the actual gust and maneuver loads experienced with the design gust and maneuver loads.
Author

N71-30783*# National Aeronautics and Space Administration
Langley Research Center, Langley Station, Va
SOME FACTORS THAT AFFECT THE INSPECTION OF AIRCRAFT FOR FATIGUE DAMAGE

C C. Poe, Jr and Herbert A. Leybold *In its NASA Aircraft Safety and Operating Probl.*, Vol 1 1971 391-401 refs
 Avail NTIS HC\$6 00/MF\$0 95 CSCL 13M

On the basis of fatigue crack growth and residual strength, a relationship between inspection interval and length of the smallest crack that must be detected to prevent failure within the inspection interval was determined. The effect on inspection of material, structural configuration, and aircraft load spectra was investigated. The results show that the efficient use of high-strength materials requires frequent inspection for very small cracks, that the use of stiffeners can result in a tolerance for long cracks and less frequent inspections, and that aircraft with fighter-type usage must be inspected much more frequently than aircraft with transport-type usage

Author

N71-30784*# National Aeronautics and Space Administration
 Lewis Research Center, Cleveland, Ohio

PROGRESS IN REDUCING EXHAUST POLLUTANTS FROM JET AIRCRAFT

Helmut F. Butze and Jack Grobman *In its NASA Aircraft Safety and Operating Probl.*, Vol 1 1971 p 403-416 refs
 Avail NTIS HC\$6 00/MF\$0 95 CSCL 01B

Substantial reductions in hydrocarbons and carbon monoxide emissions during idling were realized with air-assist fuel nozzles in jet aircraft exhaust pollutants tests. Under simulated take-off conditions, emissions of nitrogen oxides from the short-length combustor amounted to only about 10 percent of those from the longer commercial combustors. These results strongly point out that in order to reduce pollutant emissions at all aircraft operating conditions, a number of compromises or trade-offs are necessary. For efficient combustion during idling and for good altitude (relight capability), fuel-rich primary zones are required. Fuel-rich primary zones, however, lead to excessive smoke formation and possibly high concentrations of nitric oxide. Reductions in nitrogen oxides can be brought about by reducing the residence time in the combustor primary zone, or designing the combustor with a fuel-lean primary zone to reduce smoke formation and as short as possible from the standpoint of combustor-exit temperature distribution

E M C

N71-30785*# National Aeronautics and Space Administration
 Langley Research Center, Langley Station, Va

TRENDS IN NOISE CONTROL FOR AIRCRAFT GAS-TURBINE POWER PLANTS

David Chestnutt, Harvey H. Hubbard, and Charles E. Feiler (NASA Lewis Res. Center) *In its NASA Aircraft Safety and Operating Probl.*, Vol 1 1971 p 417-427 refs

Avail NTIS HC\$6 00/MF\$0 95 CSCL 01B

An attempt was made to identify the main sources of noise in various types of gas-turbine power plants and to indicate the state-of-the-art in noise reduction. Useful trends in design and operation are summarized for such noise sources as jet exhausts, fans, high-lift devices, and unducted rotors. A significant result is that lower noise levels generally are associated with lower velocities and lower pressure ratios

Author

N71-30786*# National Aeronautics and Space Administration
 Langley Research Center, Langley Station, Va

EVALUATION OF MEASURES OF AIRCRAFT NOISE

Philip M. Edge, Jr., Randall M. Chambers, and Harvey H. Hubbard *In its NASA Aircraft Safety and Operating Probl.*, Vol 1 1971 p 429-437 refs

Avail NTIS HC\$6 00/MF\$0 95 CSCL 01B

The development of measurement units to properly represent human responses to aircraft noise is reported. Accurate units for use in the systematic design of quieter aircraft to meet noise specifications and in various aspects of aircraft noise certification are discussed. Units which are simple in concept and easy to use in connection with the prediction of community annoyance and complaint patterns, land use planning near airports, and airport traffic monitoring and control are included. The nature of the airport noise problem in communities near airports and the significant factors in noise-induced responses are indicated. The psychophysiological characteristics of people which are significant in their responses to noise are summarized as well as the physical characteristics of the aircraft noise stimuli. The nature of the airport traffic, including the use of preferential runways, the mix of aircraft types, and flight scheduling, and community environment considerations, including background noise levels, economic factors, and types of community activities are covered

Author

N71-30787*# National Aeronautics and Space Administration
 Langley Research Center, Langley Station, Va

STATUS OF STUDIES IN SONIC BOOM

Domenic J. Maglieri, Harry L. Carlson, and Norman J. McLeod (NASA Flight Res. Center) *In its NASA Aircraft Safety and Operating Probl.*, Vol 1 1971 p 439-456 refs

Avail NTIS HC\$6 00/MF\$0 95 CSCL 01B

Results are presented from experiments which update the existing information relative to supersonic operations and broaden the flight regimes to include operations at hypersonic speeds and low supersonic speeds. The significant factors which affect the sonic boom include airplane design, which involves weight, size, and volume and lift distributions, airplane operations, which involve altitude, Mach number, and flight path, and the atmosphere, which involves pressure, temperature, and wind gradients and turbulence. Discussions of the effects of each of these factors as they relate to the three operating regimes are presented

Author

N71-30800*# West Virginia Univ., Morgantown. Summer
 Predoctoral Fellowship Program in Engineering Systems Design

FUTURE AIR TRAFFIC. A STUDY OF THE TERMINAL AREA

Richard E. Schmotzer, Albert N. Andry, Michael G. Harris, and Gerald F. Reid, eds. 1970 373 p refs
 (Grant NGT-49-001-045)

(NASA-CR-119287) Avail NTIS HC\$6 00/MF\$0 95 CSCL 01E

The processes involved in the systems design of terminal area air traffic control systems through the year 2000 are outlined. The demand and terminal area performance characteristics of aircraft were determined by looking at today's demand and types of aircraft and extrapolating the data to the year 2000. Air traffic control methods, takeoff and landing criteria, and air collision avoidance procedures and hardware were formulated to minimize, safely and economically, terminal area operation time for the year 2000. A simulation model was developed for terminal area operation for the present day system and for the future. The model permitted tradeoff studies such as new runways versus new airports or straight-in approaches versus curved approaches

Author

N71-30813*# National Aeronautics and Space Administration
 Langley Research Center, Langley Station, Va

EFFECTS OF NOSE BLUNTNESS ON THE STATIC AERODYNAMIC CHARACTERISTICS OF A CRUCIFORM-WING MISSILE AT MACH NUMBERS 1.50 TO 2.86

Roger H Fournier and M Leroy Spearman Washington Jul 1971 31 p refs

(NASA-TM-X-2289, L-7729) Avail NTIS CSCL 01A

Three nose shapes (an ogive nose, a nose of intermediate bluntness, and a hemispherical nose) were tested at Mach numbers from 1.50 to 2.86. The model had delta wings with a leading edge sweep angle of 72 deg. The results are summarized in the form of various pertinent aerodynamic parameters as a function of Mach number. Although no detailed analysis of the results is made, a summary of results is useful in demonstrating the importance of variations in nose bluntness and should be useful in providing a source of systematic experimental data for future correlation with analytical techniques. A brief correlation was made between the theoretical and experimental values of axial-force coefficient at zero angle of attack only, and the agreement was reasonably good.

Author

N71-30817* National Aeronautics and Space Administration
Lewis Research Center, Cleveland, Ohio

PRELIMINARY INVESTIGATION OF DIFFUSER WALL BLEED TO CONTROL COMBUSTOR INLET AIRFLOW DISTRIBUTION

Albert J Juhasz and James D Holdeman Washington Jul 1971 18 p refs

(NASA-TN-D-6435, E-6278) Avail NTIS CSCL 21E

Velocity profile control tests were conducted with a short annular diffuser equipped with wall bleed capability. The diffuser area ratio was 4, and the length to inlet height ratio was 1.5. Results show that the diffuser radial exit velocity profile may be shifted towards either the inner or outer diffuser wall by, respectively, bleeding off a small fraction of the total flow through the inner or outer wall. Based on these results, application of the diffuser bleed technique to a gas turbine combustor should be considered. The advantages of such a combustor could be shorter length, reduced idle exhaust emissions, and improved altitude reflight capability.

Author

N71-30837 World Meteorological Organization, Geneva (Switzerland)

A PRELIMINARY ANALYSIS OF SOME OBSERVATIONS OF WIND SHEAR IN THE LOWEST 100 FEET OF THE ATMOSPHERE FOR APPLICATION TO THE PROBLEM OF THE CONTROL OF AIRCRAFT ON APPROACH

Charles F Roberts *In its Vertical Wind Shear in the Lower Layers of the Atmosphere* 1969 p 203-218 refs

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Measurements of wind shear in the lowest few hundred feet of the atmosphere are provided and analyzed as to their possible significance for aircraft approach. Wind shear values ranging between 3 and 6 knots per hundred feet appear to be characteristic of the lowest one hundred feet of the atmosphere under widely varying stability conditions. Extreme values of up to 10 knots per hundred feet were observed on one or two occasions. The expected upper limit of wind shear developed under some rather restrictive assumptions shows general agreement with observed values.

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N71-30848* National Aeronautics and Space Administration
Langley Research Center, Langley Station, Va

STUDIES AND TESTS OF A PLANE WHICH ABSORBS STRONG WIND GUSTS [ETUDES ET ESSAIS D'UN AVION ABSORBEUR DE RAFALES]

Rene Hirsch Washington Jul 1971 31 p refs Transl into ENGLISH from Doc Aero (Paris), no 42, Jan 1957 p 13-28

(NASA-TT-F-13754) Avail NTIS CSCL 01A

The problem of wind gust absorption by aircraft structures is discussed. Topics presented include: structure of atmospheric wind gusts, effects of wind gusts on the classic plane, general characteristics of the wind gust absorber, construction, and test flights of the prototype H-100.

F O S

N71-30852* Techtran Corp; Glen Burnie, Md

LIFTING SURFACE THEORY FOR AN AIRPLANE WING WITH A JET FLAP [TRAGELAECHENTHEORIE FUER TRAGELUEGELMIT STRAHLKLAPPEN]

A Das Jul 1971 88 p refs Transl into ENGLISH from German report DFL-093

(Contract NASw-2037)

(NASA-TT-F-13714, DFL-093) Avail NTIS CSCL 01A

A method for the calculation of the lift distribution for wings of finite span with jet flaps is given. The method is applicable for incompressible flow and is an extension of the lifting surface theory. It can also be applied to wings of arbitrary planform (e.g., swept wings and delta wings) with an arbitrary distribution of jet momentum along the span. The jet flap characteristics of the two-dimensional airfoil theory are included. In order to obtain an essential simplification of the problem, the two-dimensional vorticity distribution along the wing chord is approximated in such a way that the section-lift coefficient and the section-moment coefficient of the airfoil are the same as in the exact solution. The calculation of the lift distribution is carried out in the usual way in the lifting surface theory. The chordwise vortex distribution is determined at several spanwise sections both on the wing and in the jet sheet from which the lift and moment distribution along the wing span is obtained. Some numerical examples were calculated for a straight rectangular wing and a swept wing. The theoretical and experimental results are in very good agreement.

Author

N71-30887* Air Force Inst of Tech, Wright-Patterson AFB, Ohio School of Engineering

INVESTIGATION OF GUIDE-SLOPE INFORMATION RATE REQUIREMENTS FOR A LOW-VISIBILITY AIRCRAFT LANDING

Meyer D Zuckerman (M S Thesis) Mar 1971 85 p refs

(AD-722655, GE/EE/71-30) Avail NTIS CSCL 17/7

The glide-slope information rate requirement for a low-visibility landing approach is studied. The analysis uses a Kalman filter-optimal control combination to simulate the control system of a DC-8. Both noisy and noise free measurements are considered. The results consist of a measure of the probability of missing an approach, as a function of the sample rate of the scanning beam landing guidance. Results indicate a knee at 6 samples per second, with rapid changes in performance in the region from 2-6 samples per second. The position of the knee appears to be insensitive to changes in either deterministic winds or airspeed constraints.

Author (GRA)

N71-30940* Society of British Aerospace Companies Ltd, London (England)

INTO THE SEVENTIES A FUTURE PLAN FOR BRITAIN'S AEROSPACE INDUSTRY

7 Feb 1969 16 p

Avail NTIS

An economic appraisal is made of the recent achievements, and it is shown that it is highly important for the national economy that Government-industry cooperation continue and be strengthened. Positive proposals for the future development of the industry are stated with respect to civil aircraft, military aircraft, aircraft engines, guided weapons, aerospace equipment, and space technology.

Author

N71-31061# Council for Scientific and Industrial Research, Pretoria (South Africa)

THE PROBLEMS OF SQUALLS AT MACH 1 [DAS BOENPROBLEM BEI DER MACHZAHL 1]

I Teipel 1970 4 p ref Transl. into ENGLISH from Z Angew Mech. (West Germany), v 48, no 8, 1968 p 246-247

Avail NTIS

The stresses to which an aircraft is subjected in the transonic range are calculated, the basic problem is the extent to which linear equations are valid for the range of low frequencies. In case of low time accelerations the results approach those of the stationary nonlinear theory. In order to solve this problem an attempt is made to find an approximate solution of the nonlinear potential equation for the disturbed flow in the transonic range.

Author

N71-31064# National Aviation Facilities Experimental Center, Atlantic City, N.J.

DEVELOPMENT AND TEST OF THE EXPLOSIVE EXIT CONCEPT FOR CIVIL TRANSPORT AIRCRAFT Final Report.

Jul. 1968 - Oct. 1970

Joseph J Jaglowski, Jr. July 1971 41 p ref (FAA-RD-71-22, FAA-NA-71-11) Avail NTIS

The test program was performed to evaluate the liquid explosive emergency exit system reliability, performance, and hazards to personal safety when exposed to environments which might be encountered before, during, and after a crash. The report includes (1) a test program to evaluate the liquid explosive emergency exit system when exposed to environment simulating conditions encountered before, during, and after a crash, (2) results of the tests, (3) evaluation of retaining shield in attenuating the sound level and containment of the debris produced by the detonation of the linear shaped charge, and (4) the feasibility of adapting the liquid explosive emergency exit system for use on civil transport aircraft.

Author

N71-31065# Council for Scientific and Industrial Research, Pretoria (South Africa)

EFFECT OF ELASTICITY OF AN AIRCRAFT STRUCTURE ON THE DEFLECTION OF ELEVATOR CONTROL LEVER AND ON THE CONTROLLING FORCES DURING STABLE FLIGHTS [VLIV NETUHOSTI KONSTRUKCE LETOUNU NA VYCHYLKY RIDICI PAKY VYSKOVKY A NA RIDICI SILY V USTALENYCH LETECH]

Vladimir Tichopad 1969 40 p refs Transl. into ENGLISH from Zpravod Vyzkumny a Zkusebni Letecky Ustav (Letnany), 1968 p 15-27

Avail NTIS

General relations for the variation in the control lever deflection and controlling forces with flight speed, including the effect of aircraft compressibility and deformation, are deduced. The relations proposed here distinguish simply and clearly between the effects of deformation, Mach number and the simultaneous interaction of both, and determine such effects from the aerodynamic and rigidity characteristics of aircraft.

Author

N71-31075# Wyle Labs, Inc., Rockville, Md. Research Staff
EFFECTIVE PERCEIVED NOISE LEVEL EVALUATED FOR STOL AND OTHER AIRCRAFT SOUNDS Final Report

B D Adcock and J B Ollerhead May 1970 117 p refs (Contract FA-67-WA-1731)

(WR-70-9, FAA-NO-70-5) Avail NTIS

A paired comparison experiment was conducted in which a group of thirty-two subjects evaluated, in a progressive wave field, the noisiness of sixty recorded aircraft flyover sounds. Thirty

of these recordings were from short take-off and landing (STOL) aircraft. The complete set included a wide range of turbofan, turbojet, piston engine and turboprop powered aircraft in a variety of categories. The results were analyzed to test the ability of the Effective Perceived Noise Level (EPNL) and other scales to predict the subjective responses. Because the sample of aircraft sounds was unusually large in number, variety, dynamic range and duration, the test was considered to be severe. The main conclusion of the study is that the EPNL procedure performs as well for the STOL sounds as it does for the CTOL (conventional take-off and landing aircraft) sounds and may thus be used with equal confidence for rating the sounds of aircraft in both classes. When the sounds were divided into propulsion system categories it was found that EPNL, in common with other scales, performed most consistently for jets, piston engine aircraft and turboprops, in that order. In general, the integrated duration correction proved superior to an approximate correction based on the 10 dB-down duration. Analysis of the results showed that the average magnitude of the tone-correction was more than 3 db and that corrections were automatically applied in practically all cases. In the case of propeller aircraft sound it is apparent that low frequency harmonics invoke tone corrections, whereas the subjective results suggest they are not required. It is recommended that the automated procedures for tone identification need some revision but that in the meantime, EPNL may be improved by ignoring tones identified at frequencies less than about 500 Hz.

Author

N71-31096*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio

INLET NOISE SUPPRESSOR PERFORMANCE WITH A TURBOJET ENGINE AS THE NOISE SOURCE

John F Groeneweg, Charles E Feiler, and Loren W Acker Washington Jul 1971 35 p refs

(NASA-TN-D-6395, E-6181) Avail NTIS CSCL 20A

Inlet noise suppressors having a perforated plate over honeycomb wall construction were evaluated over a range of passage heights and engine speeds using a turbojet engine as a noise source. Measured sound power attenuation spectra were compared to values predicted by a combination duct propagation and wall impedance model. Noise floors existing in the experiment limited the maximum measurable attenuations to about 20 dB. The model predicted the frequencies at which peak attenuation occurs and the trends in attenuation magnitude within the limits imposed on the data by the noise floors. However, the measured attenuation bandwidths were usually substantially greater than predicted.

Author

N71-31102# Council for Scientific and Industrial Research, Pretoria (South Africa) Foreign Language Information Service

NOTE ON THE DEVELOPMENT OF PULSE JETS WITHOUT FLAP VALVES [NOTE SUR LE DEVELOPPEMENT DES PULSO-REACTEURS SANS CLAPETS]

R Marchal et al Feb 1970 25 p refs Transl. into ENGLISH from the publ. 'Association Technique Maritime et Aeronautique, Session 1963' p 1-20 /ts Ref. No. 827

Avail NTIS

The development and the methods used from the invention of pulse jets without flap valves (1944) up to the development of the most recent high speed machines are discussed. The basic principles of the Escopette, the Ecrevisse, machines streamlined for the propulsion of drones, the static pulse jet group and finally the machine without shock waves, capable of functioning at speeds approaching the speed of sound are described.

Author

N71-31106*# Jet Propulsion Lab., Calif Inst of Tech., Pasadena
JPL QUARTERLY TECHNICAL REVIEW, VOLUME 1, NO. 2
 Jul 1971 269 p refs
 (Contract NAS7-100)
 (NASA-CR-119315) Copyright Avail NTIS

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- 12 IMPROVEMENTS IN DEEP SPACE TRACKING BY USE OF THIRD ORDER LOOPS R C Tausworthe p 96-106 refs
- 13 NON-ORTHOGONAL REDUNDANT CONFIGURATIONS OF SINGLE AXIS STRAPPED DOWN GYROS A K Bejczy p 107-118 refs
- 14 ANALYTICALLY DETERMINED RESPONSE OF A 300-MICRONS SILICON DETECTOR TO A POLYENERGETIC BEAM OF NEUTRONS M Taherzadeh p 119-130 refs
- 15 REMOTE EXAMINATION OF ROCK SPECIMENS J D Burke, R Choate, and R B Coryell p 131-143 refs

N71-31107*# Jet Propulsion Lab., Calif Inst of Tech., Pasadena
 Environmental Sciences Div
A COMPARISON BETWEEN PLANAR AND NONPLANAR FREE-FLIGHT DATA
 P Jaffe *In its* JPL Quart Tech Rev., Vol 1, No 2 Jul 1971
 p 1-8 refs
 Copyright Avail NTIS CSCLO1A

Results from a program designed to explore the difference between the planar and nonplanar dynamic stability coefficient, using a bi-planar wind tunnel, free flight system, are presented. Two widely different configurations, a blunt 60-deg half-angle cone and a sharp 10-deg half-angle cone were tested. The overall accuracy of the data was extremely high and firmly demonstrates the

capability of the technique. Although no dramatic difference in the coefficients was apparent from the data, which was limited in number, they do suggest that there is a favorable increase in the coefficient as the motion becomes more nonplanar. Author

N71-31108*# Jet Propulsion Lab., Calif Inst of Tech., Pasadena
 Environmental Sciences Div
AERODYNAMIC OF VEHICLES IN TUBES
 D W Kurtz *In its* JPL Quart Tech Rev., Vol 1, No 2 Jul 1971
 p 9-16
 Copyright Avail NTIS CSCLO1A

A 21.5 m long, 5.3 cm diameter, vertically oriented aluminum tube utilizing gravity to propel test models is described. This tube is used to test and determine aerodynamic characteristics of models under conditions of high blockage. Some initial results on the drag and pressure signature of a traveling model are presented. J A M

N71-31109*# Jet Propulsion Lab., Calif Inst of Tech., Pasadena
 Environmental Sciences Div
AEROBRAKING OF HIGH-SPEED GROUND TRANSPORTATION VEHICLES
 W Marko *In its* JPL Quart Tech Rev., Vol 1, No 2 Jul 1971
 p 17-22
 Copyright Avail NTIS CSCLO1A

An aerodynamic testing program was initiated to perform initial investigations on the effectiveness of a series of aerodynamic brakes on a long cylindrical body. Preliminary results from a low subsonic wind tunnel test using three standard test techniques are discussed. A moving-model drop-wire facility was constructed, and initial testing is currently underway. This data, which more correctly simulates the viscous interactions of the model with the ground plane, are compared with the wind tunnel data and used to develop analytical prediction methods. Author

N71-31134*# National Aeronautics and Space Administration
 Lewis Research Center, Cleveland, Ohio
LUBRICATION, FRICTION, AND WEAR IN AIRCRAFT
 Robert L Johnson and Lawrence P Ludwig [1971] 72 p refs
 Presented at 32d Meeting of Struct and Mater., London, 28 Mar - 2 Apr 1971, sponsored by AGARD
 (NASA-TM-X-67872) Avail NTIS CSCLO11H

Some anticipated and present friction and wear problems in aircraft are discussed and potential approaches for mitigation of these problems are outlined. The status of atomistic and continuum methods for defining surfaces and modes of failure is described. Wear processes are explored in terms of physical and chemical considerations and basic types of wear mechanics are characterized. Solid and liquid lubricant status is generalized. Lubrication by boundary, elastohydrodynamic, and fluid films are conceptually described. Lubrication systems are discussed in regard to future applications. Attention is given to particular problems of specific mechanical components (i.e., bearings, seals, gears, fasteners, etc.). Some approaches are suggested for the study of component wear due to fretting, erosion, scuffing, pitting, and other forms of damage. Author

N71-31154*# Dynasciences Corp., Blue Bell, Pa. Scientific Systems Div
A DESIGN SUMMARY OF STALL CHARACTERISTICS OF STRAIGHT WING AIRCRAFT
 M A McVeigh and E Kisielowski. Washington: NASA Jun 1971 223 p refs
 (Contract NAS1-8389)

(NASA-CR-1646, DCR-305) Avail NTIS CSCL01A

A method of wing design using lifting line theory was computerized and used to study the parameters which affect wing stall characteristics. The results of the study and the computer program are described. The effects of airfoil section variations, Reynolds number, aspect ratio, wing twist and taper ratio are presented in design chart form. Author

N71-31183# California Univ., Berkeley Div. of Aeronautical Sciences

THE EFFECT OF SECOND ORDER ELASTIC TERMS IN SUPERSONIC PANEL FLUTTER OF FINITE CYLINDRICAL SHELLS

James C. S. Meng, Lien S. Yao, and M. Holt Dec 1970 28 p refs

(Grant AF-AFOSR-0268-67)

(AD-722447, AS-70-9, AFOSR-71-0943TR) Avail NTIS CSCL 20/4

An analysis for the flutter boundary of a finite isotropic cylindrical shell under no static stress in a supersonic free stream is carried out at Mach numbers from 3-10. The effect of second order terms in the elastic equilibrium equation, which was not considered by Li (1967), is examined in detail. The aerodynamic load is computed following the same approximation used by Li (1967), and the elastic displacement of the shell is resolved into a linear combination of sine functions to satisfy the clamped boundary condition at one end and simply supported conditions at the other end. This homogeneous system is solved by Galerkin's method. Then the resultant matrix is transformed into a convenient form, having the same characteristic equation, and expressed in triangular form by means of QR-transformations. The required eigenvalues are the diagonal elements of the transformed matrix. The flutter boundary is defined as the curve where the imaginary part of the eigenvalue becomes negative. It is found that the effect of the second order terms is small. Author (GRA)

N71-31191*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio

THE NASA QUIET ENGINE

James J. Kramer 1971 21 p refs. Proposed for presentation at the 1971 Natl. Aeron. and Space Eng. and Manuf. Meeting, Los Angeles, 27 Sep - 1 Oct 1971. Sponsored by the Soc. of Automotive Engrs.

(NASA-TM-X-67884) Avail NTIS CSCL 21E

The NASA Quiet Engine Program to incorporate all available noise reduction technology into a propulsion system suitable for subsonic civil transport aircraft is discussed. Full-scale experimental hardware is being built and tested primarily for noise performance. The program is in process and component tests to date indicate that it is possible to achieve or exceed noise reduction objectives of 15-20 perceived noise decibels below the levels of 707/DC-8 long-range transport aircraft. Author

N71-31204 Illinois Inst. of Tech., Chicago

FLOW-FIELD AND PERFORMANCE STUDY OF AN AUGMENTED RAM-WING VEHICLE CONCEPT

Imants Reba (Ph.D. Thesis) 1970 243 p

Avail. Univ. Microfilms Order No. 70-17255

An experimental investigation of a vehicular concept with potential for high speed ground transportation of the future is described. The investigation consists of two parts: (1) a study of flows in the gap between the model underside and the ground at static conditions and (2) a wind-tunnel study to evaluate concept potential under dynamic conditions. The flow field studies, composed of flow visualization experiments and static and total pressure

measurements, yielded information about the effects of underside contour, ground height, slit size and orientation on flow field behavior and static pressure recovery. Wind tunnel studies were conducted in the presence of a moving ground plane and at free-stream velocities of 80.5 and 111 feet per second. Integration of static pressures over the model surface yielded vertical and horizontal force components which in the presence of blowing were corrected for jet reaction. The augmented Ram-Wind Vehicle potential was evaluated using lift-to-drag ratio and specific speed parameters.

Dissert. Abstr.

N71-31207*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va.

A TIME-DEPENDENT METHOD FOR CALCULATING SUPERSONIC ANGLE-OF-ATTACK FLOW ABOUT AXISYMMETRIC BLUNT BODIES WITH SHARP SHOULDERS AND SMOOTH NONAXISYMMETRIC BLUNT BODIES

Richard W. Barnwell Washington Aug 1971 75 p refs

(NASA-TN-D-6283, L-7593) Avail NTIS CSCL 20D

A time-dependent numerical method for calculating supersonic flow about blunt bodies at large angles of attack is presented. The axisymmetric bodies with sharp shoulders which are treated were constructed with a generator composed of segments of constant curvature. The nonaxisymmetric bodies have continuous slope and curvature. All flow fields are inviscid and adiabatic and have one plane of symmetry. A modification to the method of characteristics is introduced for use at the shock wave. A two-step finite-difference method of second-order accuracy is used at the body surface and in the region between the shock and body. A new finite-difference technique is introduced for use at sharp sonic shoulders. Comparisons of the results of the method with experimental results and the results of other methods are made for the flow of equilibrium air past the Apollo command module at the trim angle of attack and for perfect gas flow past a spherical cap and a spherically blunted cone at angle of attack. Both the cap and the blunted cone were terminated with sharp shoulders. Results are also presented for perfect gas flow past a prolate spheroid with its major axis normal to the flow. Author

N71-31211*# Illinois Univ., Urbana

A STUDY OF THE LOCAL PRESSURE FIELD IN TURBULENT SHEAR FLOW AND ITS RELATION TO AERODYNAMIC NOISE GENERATION. Semiannual Status Report, 1 Aug. 1970 - 31 Jan. 1971

Barclay G. Jones and Burce W. Spencer 31 Jan 1971 22 p refs

(Grant NGR-14-005-149)

(NASA-CR-119359, SR-2) Avail NTIS CSCL 20D

Continuing research is reported in an investigation of the fluctuating static pressure field comprised of a pseudosound pressure field, responsible for generating sound, and true acoustic pressure field. The experimental and analytical findings are concerned with: (1) Eulerian properties of the mean static pressure field, (2) Lagrangian frame turbulence measurements, and (3) analytical Lagrangian frame turbulent structure. D L G

N71-31213# Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

CALCULATION OF THE BOUNDARIES OF THE REGION OF STABLE EQUILIBRIUM OF A ROTOR IN PRESSURIZED GAS BEARINGS

R. Z. Aliyev et al. 29 Jan 1971 16 p. Transl. into ENGLISH from Tr. Mekhan. i Protessy Upr. Vychislitel'naya Mat. (USSR), no. 307, 1969 p. 115-122.

(AD-722828, FTD-HT-23-818-70) Avail NTIS CSCL 13/9

A study is reported of the stability of the equilibrium state of a rotor in a pressurized gas bearing. The equations for the perturbed motion of the rotor are considered together with the Reynolds equations for the pressures in the lubricant layer. The conditions of equilibrium stability are established by the small perturbation method in a linear approximation. A numerical method of solving the basic equations is outlined, and the results of certain computer calculations are presented. GRA

N71-31242*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
A METHOD FOR ESTIMATING SOME LONGITUDINAL AND LATERAL RIGID-BODY RESPONSES OF AIRPLANES TO CONTINUOUS ATMOSPHERIC TURBULENCE

Ellwood L Peele Washington Aug 1971 45 p refs
 (NASA-TN-D-6273, L-7504) Avail NTIS CSCL 01C

A method is presented for estimating some lateral and longitudinal rigid-body responses of airplanes to random atmospheric turbulence. Estimates of center-of-gravity load factors and motion responses can be made simply and easily through the use of parametric charts. Sample calculations are included to illustrate the method. Author

N71-31262*# Washington Univ., Seattle Aerospace Research Lab

HIGH REYNOLDS NUMBER FLOWS

David A Russell Washington NASA Jul 1971 23 p refs
 (Grant NGL-48-002-057)
 (NASA-CR-1838) Avail NTIS CSCL 20D

Available test facilities fall short of producing the full-scale Reynolds numbers of modern flight vehicles by at least an order of magnitude. A conventional facility that would meet the growing need for full simulation would be prohibitively expensive, thus quasi-steady devices should be considered. The design of these devices, their capabilities and limitations, and their use in identifying and studying flows sensitive to the Reynolds number are discussed. Author

N71-31288# Northrop Corp., Hawthorne, Calif Aircraft Div
AIRPLANE FLYING CHARACTERISTICS IN TURBULENCE
Final Report, 1 Nov. 1969 - 11 Sep 1970

Edward D Onstott and Ernest P Salmon Wright-Patterson AFB, Ohio AFFDL Feb 1971 118 p refs
 (Contract F33615-70-C-1156)
 (AD-722855, NOR-70-139, AFFDL-TR-70-143) Avail NTIS CSCL 5/10

A method for predicting the performance of the total pilot-vehicle system has been developed for the lateral dynamics of Class 4 airplanes. This method, which is based on pilot model theory and multiloop analysis, predicts tracking errors for command tracking tasks and also for attitude hold tracking tasks in turbulence. The predictions are in terms of root mean square time domain statistics and are obtained by means of a fully automated multiloop analysis performance prediction program available from the United States Air Force. Thus, system performance can be evaluated analytically in terms of familiar time domain root mean square statistics. The validity and accuracy of this method have been ascertained by means of moving base simulation on the Northrop Large-Amplitude Flight Simulator operating in five-degree-of-freedom motion. Author (GRA)

N71-31303*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va

DEPLOYABLE AERODYNAMIC DECELERATION SYSTEMS SPACE VEHICLE DESIGN CRITERIA

Washington Jun 1971 88 p refs
 (NASA-SP-8066) Avail NTIS CSCL 01B

Criteria and recommended practices are presented for the design, selection, analysis, and testing of deployable aerodynamic deceleration systems. Deployable devices of all types are treated, along with their usage over a wide range of environmental and operational conditions. The principal design factors relating to textile materials, dimensional stability, and fabrication processes are considered. Primary emphasis is given to the various types of parachutes, deployable wings, inflatable envelopes, and attached or towed surfaces on which the most experience has been accumulated. Lifting balloons and autorotors are also surveyed. Author

N71-31307*# Kaman Avidyne, Burlington, Mass
STUDY OF THE CONCEPT OF INERTIALLY AIDED BAROMETRIC ALTIMETRY SYSTEM FOR SUPERSONIC AIRCRAFT

J Ray Ruetenik, John H Thompson, and Kenneth R Britting Washington NASA Jun 1971 136 p refs
 (Contract NAS12-2132)
 (NASA-CR-1770, TR-65) Avail NTIS CSCL 09E

Research needs are studied for providing a hybrid inertial barometric altimetry system to meet vertical separation requirements of 1000 and 2000 feet for Mach 3.5 transports cruising in altitude hold at 80,000 feet. The static pressure error of the barometric subsystem must be reduced an order of magnitude from present errors for subsonic jet aircraft systems. An off-the-shelf inertial subsystem having a 3 sigma accuracy of 0.002 g's should be satisfactory, provided the lag of the barometric system is 10 seconds or less. The height deviations from a flight level due to turbulence, atmospheric temperature variations, and variations in isobaric surface height are estimated to be negligible for a hybrid altimeter system. The deviations near the phugoid frequency are essentially eliminated by the system. Flight tests are recommended to verify that all the important factors have been accounted for adequately. Author

N71-31330*# National Aeronautics and Space Administration Langley Research Center, Langley Station, Va
STATIC FORCE TESTS OF A MODEL OF A TWIN-JET FIGHTER AIRPLANE FOR ANGLES OF ATTACK FROM - 10 DEG TO 110 DEG AND SIDESLIP ANGLES FROM - 40 DEG TO 40 DEG

Ernie L Anglin Washington Aug 1971 90 p refs
 (NASA-TN-D-6425, L-7808) Avail NTIS CSCL 01B

An investigation was conducted to obtain a set of static-force-test data for use as aerodynamic inputs to theoretical spin studies. Control-effectiveness tests were made for each control individually and for a full left pro-spin combination of controls. The results are presented without detailed analysis, but are analyzed in terms of factors which would affect their applicability for use in spin theory. Several data characteristics are indicated that are deemed to be of significance with regard to their intended use in theoretical spin studies. Author

N71-31333# National Transportation Safety Board, Washington, DC

AIRCRAFT ACCIDENT REPORT. FEDERAL AVIATION ADMINISTRATION, DOUGLAS DC-3C, N7 LA GUARDIA AIRPORT, NEW YORK, 4 JANUARY 1971

3 Jun 1971 12 p
 (NTSB-AAR-71-11) Avail

A Federal Aviation Administration DC-3 aircraft accident which occurred during landing at La Guardia airport, New York, on January 4, 1971 is reported. The accident investigation board determined that the cause of the accident was the pilot's failure to compensate for wind drift with atmospheric conditions as a mitigating circumstance. P N F

N71-31347# Naval Postgraduate School, Monterey, Calif.
AIRCRAFT DATA ACQUISITION SYSTEM FOR ACADEMIC FLIGHT EVALUATION

William Lansing Vincent (M S Thesis) and Alexander Martin Phillips (M S Thesis) Mar 1971 76 p refs
 (AD-722583) Avail NTIS CSCL 14/2

Various methods for investigating the stability and control characteristics of the US2A were considered in obtaining a system that would provide a proper degree of data accuracy, data availability and system reliability yet still be instructional and functional. To this end, a photo-panel system with its various input systems was designed and incorporated into the Aeronautics Departments US2A, BUNO 136533. Installation and component check-out of this photo-panel system was achieved. Author (GRA)

N71-31351*# Texas A&M Univ., College Station
AN INVESTIGATION OF THE RELATIONSHIPS BETWEEN MOUNTAIN-WAVE CONDITIONS AND CLEAR AIR TURBULENCE ENCOUNTERED BY THE XB-70 AIRPLANE IN THE STRATOSPHERE

Thomas P. Incrocci and James R. Scoggins Washington NASA Jul 1971 40 p refs
 (Grant NGR-44-001-081)
 (NASA-CR-1878, H-679) Avail NTIS CSCL 04A

The data from 36 XB-70 flights conducted over the mountainous regions of the western United States together with rawinsonde data were used to investigate relationships between conditions favorable for mountain waves and clear air turbulence. Profiles for the Scorer parameter and the gradient Richardson number were evaluated from an eight-level model. The Scorer parameter and the gradient Richardson number profiles were computed from the rawinsonde data on those days when the XB-70 flew, and these results compared to the model profiles and related to the reported turbulence. Ascent rate profiles of rawinsonde balloons were analyzed from which the presence of mountain or lee waves was inferred. From the results of this investigation, objective methods were developed for forecasting the occurrence or nonoccurrence of turbulence in the stratosphere due to mountain waves. Author

N71-31376# Cornell Aeronautical Lab., Inc., Buffalo, N Y
FIRE FIGHTER'S EXPOSURE STUDY. Final Report, Jul. - Nov. 1970

Kenneth W. Graves Dec 1970 88 p refs
 (Contract F33615-70-C-1715)
 (AD-722774, CAL-HM-2972-Z-1, AGFSRS-71-2) Avail NTIS CSCL 13/12

Experimental fires from pools of burning aircraft fuels were instrumented with heat meters to determine heat flux distributions for application to the design of protective clothing for firefighting personnel. The spectral distribution of infrared radiation emitted by fires was also measured. Conditions affecting the fires and the resulting heat effects that were studied were wind velocity, fuel pool area, time of burning, orientation around the fire relative to wind direction, distance from the fire, and an extraneous object in a fire. A means by which evaluation of reflective clothing can be made is described. Author (GRA)

N71-31400# Naval Postgraduate School, Monterey, Calif
EVALUATION OF AN ELECTRONIC WIND-TUNNEL BALANCE

Steven Russell Briggs (M S Thesis) Mar 1971 61 p refs
 (AD-722571) Avail NTIS CSCL 14/2

A three-component electronic wind-tunnel balance installed in a 35 by 50 foot subsonic tunnel was evaluated for system problem areas. The nonlinear output of the reluctance gage transducers was analyzed and linearized using diode function-generating circuitry. A static calibration was conducted to confirm the linearity of the circuits. Evaluation of the balance system under operating conditions pointed out other areas for future investigation. Author (GRA)

N71-31403# Committee on Commerce (U S Senate)
AIR POLLUTION CREATED BY AIRCRAFT JET ENGINE EMISSIONS

Washington GPO 1970 39 p Joint Hearing Before Comm on Com and Comm on Public Works, 91st Congr., 2d Sess., 4 Feb 1970. Prepared in cooperation with Comm on Public Works. Its Serial No 91-85
 Avail Comm on Com and Subcomm on Air and Water Pollution CSCL 13B

Statements on the development of engines and devices for the control of air pollution from jet aircraft engine emissions are presented. Research allocations for the reduction of smoke emissions are discussed as well as emission standards and the relocation of airports. J M

N71-31455*# Scientific Translation Service, Santa Barbara, Calif
REQUIREMENTS OF ENGINE DYNAMICS IMPLIED BY THE THRUST MODULATION CONTROL FOR VTOL AIRCRAFT [ANFORDERUNGEN AN DIE TRIEBWERKSDYNAMIK BEDINGT DURCH DIE SCHBMODULATIONSSTEUERUNG BEI VTOL-FLUGZEUGEN]

H G Offenbeck Washington NASA Jul 1971 9 p Transl into ENGLISH from Proceedings of the WGLR Meeting on Air Breathing Eng (Munich), Dec 1969 p 231-238
 (Contract NASw-2035)
 (NASA-TT-F-13755) Avail NTIS CSCL 21E

In the design of V/STOL high performance aircraft, the choice of the engines and the control systems plays an important role for gliding and transition flight. For the control system, and the choice of engine for thrust modulation control, there are three dynamic criteria: stabilization for small disturbances, stabilization for engine failure, and control behavior. Author

N71-31456*# National Aeronautics and Space Administration
 Lewis Research Center, Cleveland, Ohio

USE OF AN AIR-ASSIST FUEL NOZZLE TO REDUCE EXHAUST EMISSIONS FROM A GAS TURBINE COMBUSTOR AT SIMULATED IDLE CONDITIONS

Daniel Briehl and Leonidas Papathakos Washington 1971 21 p refs
 (NASA-TN-D-6404, E-6247) Avail NTIS CSCL 21E

Tests were performed at typical engine idle conditions on a single J-57 combustor liner installed in a 30-cm-(12-in-) diameter pipe to evaluate design modifications for reducing exhaust emissions. Using an air-assist fuel nozzle, the combustion efficiency was increased from 90.3 to 96.5 percent, and the total hydrocarbon and carbon monoxide exhaust emissions were reduced from 26.3 to 3.3 and from 51 to 40 g/kg of fuel burned, respectively. A corresponding increase in nitric oxide emissions from 0.8 to 1.5 g/kg of fuel burned was observed. Calculations performed for a complete landing-takeoff cycle of a typical engine indicated that the

use of an air-assist nozzle during idle could decrease the total quantity of hydrocarbon and carbon monoxide emission by 69 and 20 percent, respectively, while nitric oxide would increase by 14 percent. The required secondary nozzle airflow amounts to less than 0.5 percent of the total engine airflow at idle. Author

N71-31459# Advisory Group for Aerospace Research and Development, Paris (France)

TECHNICAL EVALUATION REPORT ON AGARD SPECIALISTS' MEETING ON AERODYNAMIC INTERFERENCE

David J. Peake. May 1971. 18 p. refs. Conf. held at Silver Spring, Md., 28-30 Nov. 1970. (AGARD-AR-34-71) Avail. NTIS

A critique of topics discussed at the AGARD meeting on aerodynamic interference is presented. Discussions evaluated include wing-body and wing-body-tail interference, airframe-propulsion interactions, and airframes-stores interference. The major advance is considered to be the treatment of a lifting wing-body combination in which a sheet of trailing vorticity from a wing was coupled with the finite element method. It is recommended that a calibration model of a wing-body combination be chosen for checking various computation schemes, and some high Reynolds number wind tunnel tests be conducted to provide details of the junction pressure distributions and the three-dimensional boundary layers and wakes. F O S

N71-31463# Kaiser Engineers, Oakland, Calif.
TRANSIT ACCESS FEASIBILITY STUDY FOR OAKLAND AIRPORT ACCESS TASK FORCE. Final Report
15 Oct. 1970. 77 p. refs. Sponsored by Dept. of Transportation (PB-197837, UMTA-CAL-T9-9-70, Rept. 70-54-RE) Avail. NTIS CSCL 13B

To respond to the need to increase speed, reliability and convenience of surface transportation link of air flight trip, this study developed plans for improved transit services in the study area, examined the feasibility of those plans, and recommended means of implementing and funding. The effort was to connect the airport to the rapid transit system. The choice of extending BART (the rapid transit system) to the airport or install a separate connector system was considered. The Oakland Airport Connector System was selected as more advantageous because of lower cost and more frequent service. A comparison of the various Oakland Airport Connector Systems found a small vehicle service to be the most attractive as far as service, flexibility, and cost.

Author (GRA)

N71-31482*# Shell Development Co., Emeryville, Calif.
HEAT SINK CAPABILITY OF JET A FUEL. HEAT TRANSFER AND COKING STUDIES

L. E. Faith, G. H. Ackerman, and H. T. Henderson. Jul. 1971. 68 p. refs.

(Contract NAS3-12432)

(NASA-CR-72951, S-14115) Avail. NTIS CSCL 20M

Experiments were run with Jet A fuel to determine the heat transfer characteristics and coking problems associated with the operation of supersonic turbine aircraft extended by using more heat sink of the fuel for cooling. Selection of the fuel used was based on coker tests of fuels from several sources. Heat transfer to the fuel was studied and correlations were developed for both laminar and turbulent flow of the fuel. Considerable free convection in laminar flow enhanced the heat transfer and stabilized the flow at Reynolds numbers up to 15,000. Tests showed that the tube temperature was the most important variable in determining

deposition rate. Coke deposits were found to have two effects on heat transfer, a beneficial effect by acting as a turbulence promoter to increase the convective heat transfer coefficient and a detrimental effect by increasing the resistance to heat transfer. Pressure oscillations in the test section were audible at certain turbulent flow conditions when the exit fuel was near its pseudocritical temperature. Amplitudes ranged up to 350 psi and primary frequencies varied from 1000 to 5000 Hz. Author

N71-31511# Committee on Finance (U. S. Senate)

SKYJACKING

Washington. GPO. 1970. 26 p. refs. Hearing on H. R. 19444 before Comm. on Finance, 91st Congr., 2d Sess., 6 Oct. 1970.

Avail. Comm. on Finance

Senate hearings on the Presidential proposal for financing the Federal anti-skyjacking program are presented. The bill would increase the domestic air passenger ticket tax from 8 to 8.5 percent and the international travel facilities tax for \$3 to \$5 for a temporary period from October 31, 1970 through July 1, 1972. The cost of guards on airliners would be met out of the airway trust fund established from these revenues. A C R

N71-31512# Civil Aeronautics Board, Washington, D. C.
REMARKS OF JOHN G. ADAMS, MEMBER, CIVIL AERONAUTICS BOARD BEFORE THE WINGS CLUB

Sep. 1970. 9 p. refs. Conf. held at New York, 16 Sep. 1970.

Avail. NTIS

Probable trends in U.S. air transportation during the 1970's are discussed, and the financial status of the airline industry during this period is speculated upon. Continued record breaking growth in aircraft production is anticipated, predominantly in wide-bodied jets, such as the Boeing 747. This wholesale movement toward extremely large carriers poses problems in frequency of service to many medium sized cities and may even result in its complete loss. Such a development is likely to lead to expansion of short-distance, or commuter runs using somewhat larger capacity aircraft. New strictures on the Civil Aeronautics Board's rate-making procedures are also inevitable in light of the D.C. Court of Appeals decision in Moss vs. the Board. Finally, the controversy over Board awards of new routes should ease if the Board moves cautiously in this area while the industry is attempting to digest both the many existing routes and the significant changes in aircraft design and carrying capacity. A C R

N71-31569# Scott Research Labs., Inc., Plumsteadville, Pa.
A STUDY OF EXHAUST EMISSIONS FROM RECIPROCATING AIRCRAFT POWER PLANTS. Final Report

28 Dec. 1970. 97 p. refs.

(Contract CPA-22-69-129)

(PB-197627) Avail. NTIS CSCL 21B

The exhaust emissions of light, piston engine aircraft and the phenomena of natural afterburning of the exhaust gases on contact with the ambient air were investigated. The exhaust emissions of representative aircraft were measured as they were flown in a normal manner. At the same time, the extent of afterburning was measured by sampling the exhaust plume downstream of the exhaust stack and comparing the plume composition, corrected for dilution, to the composition of the stack gases. The exhaust emissions from nine light aircraft were determined using a 9-mode takeoff-cruise-landing (TCL) cycle developed for this study. Exhaust component concentrations and fuel consumption rates were measured for each mode during ten test

flights per aircraft The pollutant concentrations were converted to emission rates per pound of fuel, per minute, per mode, per TCL cycle, and per landing-takeoff (LTO) cycle Author (GRA)

N71-31586# Ohio State Univ., Columbus Aeronautical and Astronautical Research Lab

THE INFLUENCE OF ARTIFICALLY INDUCED TURBULENCE UPON BOUNDARY LAYER TRANSITION IN SUPERSONIC FLOWS Final Technical Report, 1 Dec. 1968 - 15 Jan 1971

Lawrence E Olson, Gerald M Gregorek, and John D Lee Wright-Patterson AFB, Ohio ARL Jan 1971 118 p refs (Contract F33615-69-C-1266)

(AD-723322, ARL-71-0022) Avail NTIS CSCL 20/4

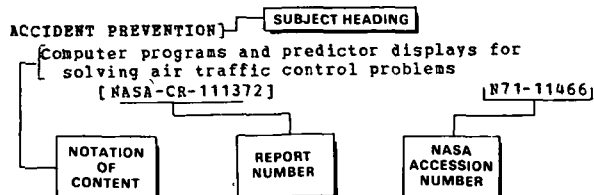
Acoustic disturbances and high frequency-low amplitude vibrations have been studied as a means to promote early boundary layer transition in a supersonic stream A theoretical analysis of the stability characteristics of the leading edge of a blunted delta-wing was used to guide the choice of acoustic and vibration frequencies employed in this experimental study Air driven acoustic generators, located in the stagnation chamber of the wind tunnel, produced a strong resonant tone at 4.6 KHz, with a sound level above 148 dB Comparison of the Reynolds number dependent flow field on a delta model at angle of attack, using an oil streak technique for flow visualization, provided an index of the effectiveness of the acoustic disturbances Operation of the tunnel with the tunnel air supplied through the acoustic generators and with the normal air supply indicated the effective Reynolds number of the wind tunnel was increased by a factor near 1.4 by the acoustic generators Extensive test section total pressure and flow angularity surveys and force and moment measurements on a winged body showed this increase in effective Reynolds number was produced with no degradation of flow quality Piezoelectric vibration transducers were mounted in the supporting sting of the delta models, vibrating the models at frequencies ranging from 2.9 KHz to 82 KHz with peak-to-peak amplitudes from 49 microns to 0.0015 inches These vibrations were not as efficient as surface roughness of a height comparable to the peak-to-peak vibration amplitude in stimulating boundary layer transition Author (GRA)

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AERONAUTICAL ENGINEERING / *A Special Bibliography (Suppl. 10)*

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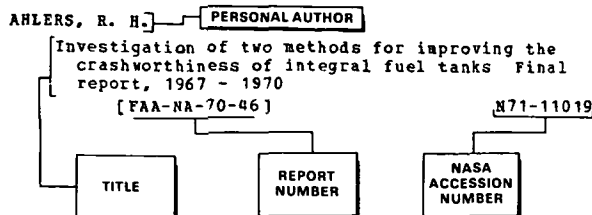
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